SAVE-IT BOOKLET: KEEPING ELECTRIC MOTORS RUNNING

POPULAR SCIENCE

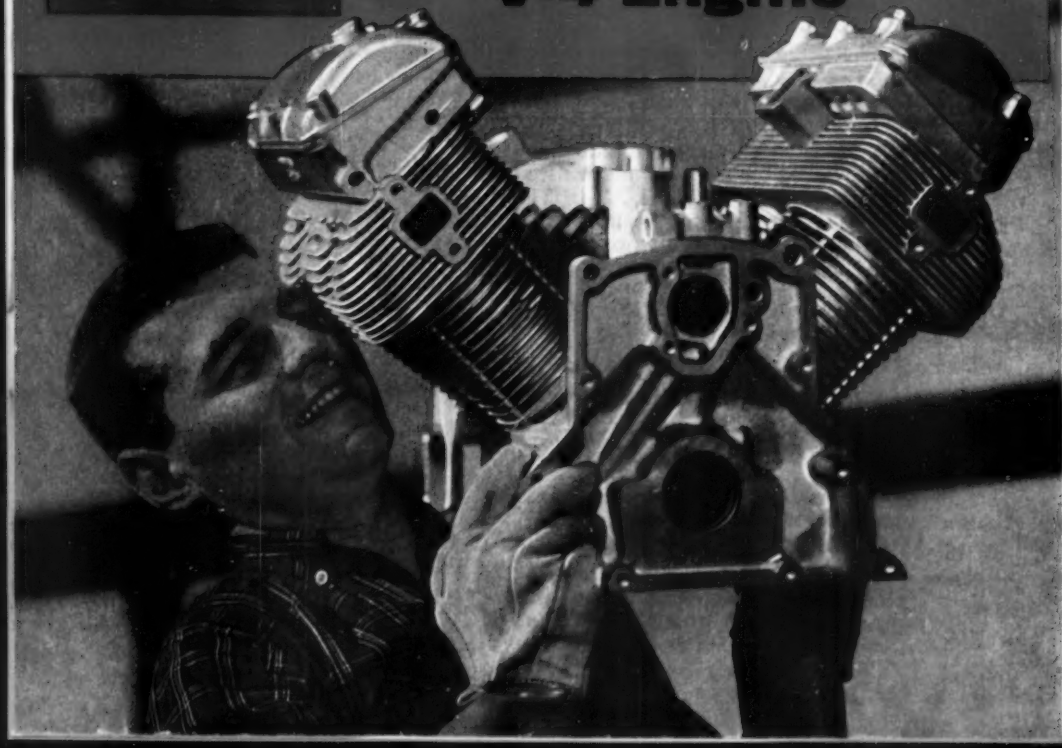
FEBRUARY · 35c

▶ The Race to Build Atomic Planes

▶ Inside the New Outboards

EXCLUSIVE!

Detroit's Aluminum V-4 Engine



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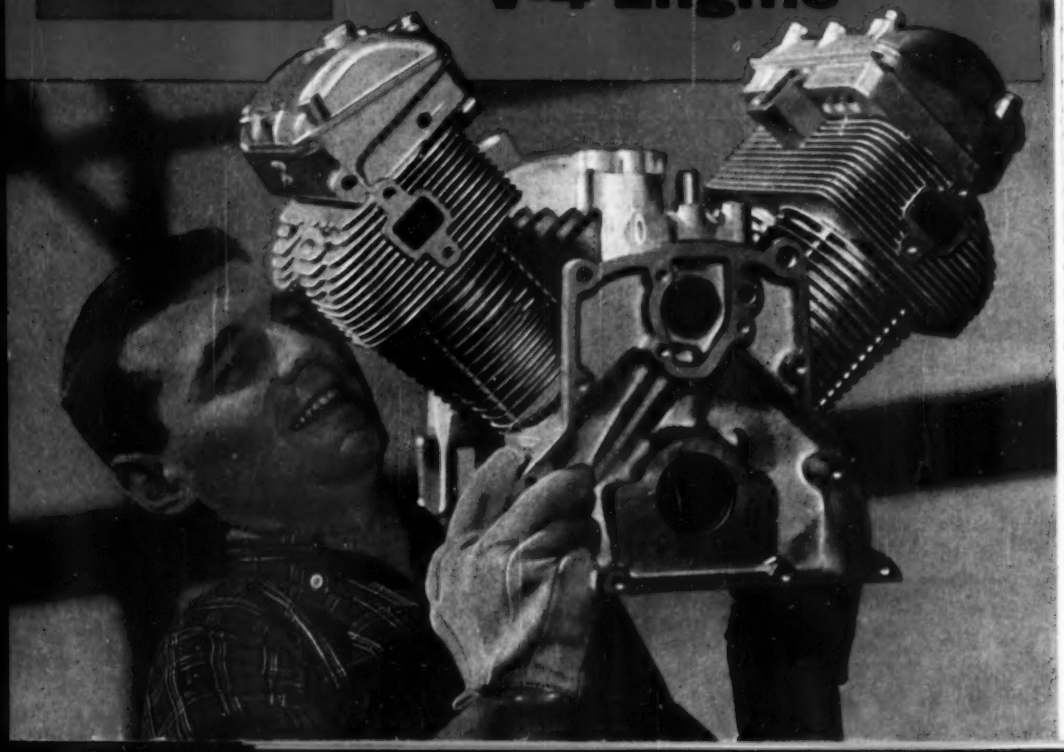

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PS-1

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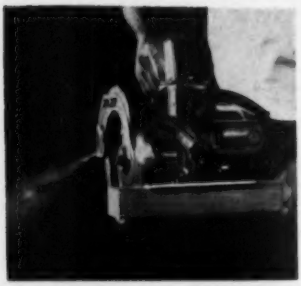
Founded in 1872 Vol. 174: No. 2 *Mechanics and Handicrafts* REG. U. S. PAT. OFF.

Popular Science Monthly

February, 1959

Cover photo by Robert D. Borst

New tires and devices—now on the way—will put firmer feet under your car . . . but the best skid preventive? Those pro tricks that mark the skilled driver.



What's new in the marketplace? PS picks out the best and most useful items—like this pivot-guard saw —and tells you all about them.

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Thrills aplenty await you in the deep-snow country when you "fly" in a homemade snowplane.

Diagrams and easy-to-follow fixes show you how to put heart in a faltering motor.

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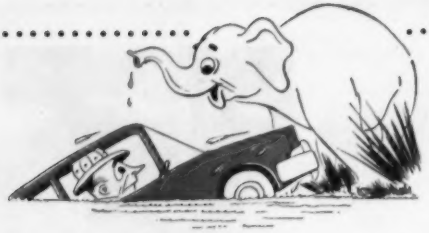
PS Readers

TALK BACK



Detroit Does Him Proud

My home lies 50 miles from "town" over a jungle road. I drive a stock U.S. '55 wagon with oversize tires, hauling 50-gal. drums of gasoline, kerosene and diesel fuel, plus bottles of oxygen and butane; and sometimes pull a trailer.

I've bulldozed my way through mud holes, swamps and even small rivers, yet the grille and front bumper are in good condition. No comparable European car around here will take this abuse and still haul big payloads like my "behemoth."

I do all the servicing and repair and I'm amazed at the workmanship in my well-assembled mass of Detroit steel. A stateside buyer may not be interested in springs and shock absorbers, their brackets, shackles and hangers and how they are bolted, riveted or welded to the chassis. A missionary overseas is vitally concerned; he'll drop to the showroom floor, assuming an Old Testament prophet's prayer position, to take a good look for himself.

P. W. Pendell, French Cameroun, Afr.

Gets Bonus in Gasoline

My subscription to your magazine was motivated by the section on car upkeep. It certainly paid off. After reading "Are You Wasting Money on Premium Gas?" [Oct.] I switched to regular and I now save on every tankful of gas.

M. J. Novik, Richmond Hill, N.Y.

The Dot on the Tire

I'll bet no one has had more trouble with tires than I, so "Taking the Trickery Out of Tire Ads" [Nov.] was sure welcome. I still have one question:

I understand the manufacturers balance every tire and stamp a little dot or pointer on each so that the tire can be lined up with the valve stem when installed on the wheel. My friends tell me that no other balancing is necessary. Are these boys correct?

Ivon S. Jarmon, Swansboro, N.C.

The dot offers a rough means of tire placement to bring rim and tube into good position relative to one another. It does not insure perfect balance.

Tired Antifreeze Okay, He Says

I agree with most of what you say about "permanent" antifreeze [Nov.], but what about adding an inhibitor?

I have used the same antifreeze for five years, adding a little each year. I leave it in the year around and in the spring and fall pour in a can of radiator protector. The radiator has never been cleaned or flushed. I replaced the radiator hose for the first time last spring, but all deterioration was on the outside.

In my opinion, the entire cooling system is in fine shape and my 1952 De Soto V-8 runs as cool as when it was new.

S. A. Gummere, Indianapolis.

He Cries Foul

The fact that a highway patrol achieved a .19 accident rate as against 1.51 for other fleet drivers ["How to Defend Yourself on the Highway," Sept.] doesn't prove to me that police are more expert drivers. I assume the police cars were readily identifiable as such.

Few drivers will zoom onto a highway in front of a patrol car, tailgate one, or pass one unless the police are traveling

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WARREN MARSHALL, Floral Park, N.Y.

Russia Goes for PS

DID you know that the Russian magazine *Tekhnika Molodezhi* (Technique for Youth) recently published a condensed translation of "Timetable to the Moon" [May, '58]? They copied your drawings and added one of their own, showing men on the moon.

What surprised me is that they gave you credit: "In the American magazine POPULAR SCIENCE, a plan is described for gradually conquering the Moon . . ." I recall that about a year and a half ago the same magazine published a photograph of the POPULAR SCIENCE earth-satellite model, claiming it as a Russian sputnik design.

If this keeps up, the Russians may some day even give the United States credit for an invention.

GERALD FISHER, Princeton, N.J.

Feller Needs a Friend

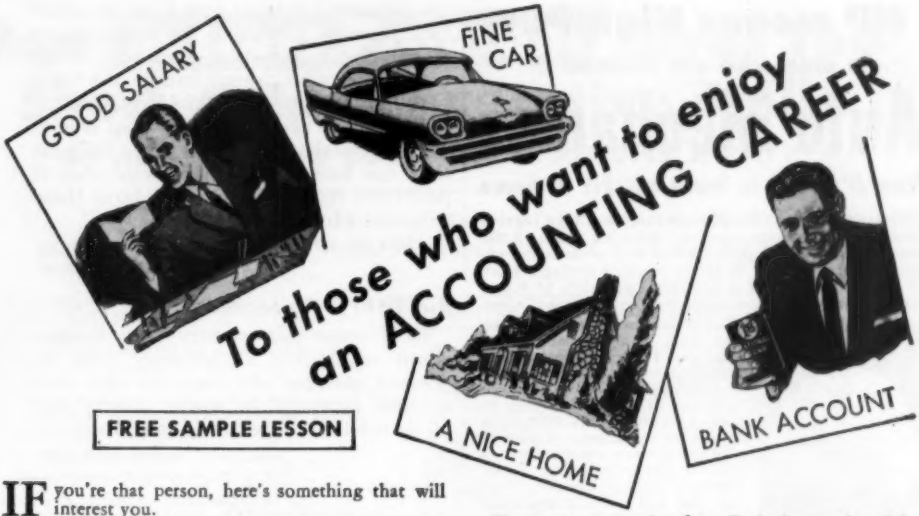
I, TOO, had a screw loose—in my eyeglasses. Following instructions ["Budget Savers," Dec.], I made a little screwdriver out of a paper clip. Then I took off the glasses to tighten them up. Now I can't see the screw or the screwdriver. What do I do next?

HOWARD JAMESON, Astoria, N.Y.

Yeah, Who Drives Them?

CRITICS of foreign cars might get as much amusement as I did from this lusty clout at cars with automatic transmissions, from the English magazine *Home Mechanics*. It might well be the British viewpoint on U. S. cars:

"It is a weird experience to drive with no gear lever or clutch pedal and it is positively uncanny to feel the gears changing themselves—which they do admirably. But while I am fascinated with



FREE SAMPLE LESSON

IF you're that person, here's something that will interest you.

Not a magic formula—not a get-rich-quick scheme—but something more substantial, more practical.

Of course, you need something more than just the desire to be an accountant. You've got to pay the price—be willing to study earnestly, thoroughly.

Still, wouldn't it be worth your while to sacrifice some of your leisure in favor of interesting home study—over a comparatively brief period? Always provided that the rewards were good—a salary of $5,000 to $10,000 and up?

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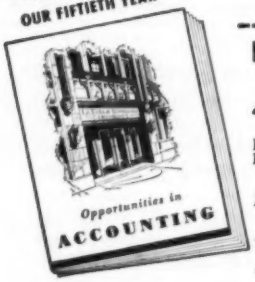

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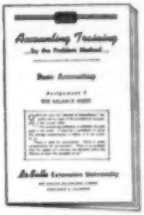

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the ingenuity of these cars, I am surprised that there is a demand for this form of transmission. Surely it is a very mediocre driver who cannot handle the truly excellent modern gearbox? I cannot really believe those people who say that changing gear the hard way is a tiring business that can lead to a fatigue point that is positively dangerous. So who buys these cars and why?"

How do you like that!

C. L. JEROLD, Chicago.

But THAT'S Propaganda!

How come this country is so modest about advertising its scientific feats on postage stamps? As soon as the first sputnik appeared in space, Russia and all its satellite countries flooded the world

with stamps glorifying their achievement. Their printing plants must have been all ready to roll the moment the sputnik went into orbit.

I have yet to see a U.S. stamp showing our man-made moon, nor have I heard anything of a stamp in preparation to commemorate the successful firing of the Atlas ICBM in a 6,325-mile shot. Yet millions of pieces of mail from this country pass through millions of hands on every continent. Each one could tell the story on the stickers in the upper right-hand corner—tiny international billboards that cost the government nothing.

C. L. JAMESON, Hartford, Conn.

Cooking with Gas!

POPULAR SCIENCE is on the magazine rack in our coffee lounge and among our employees you have a lot of satisfied customers. A very well thumbed copy is filed away each month to make room for the new one.

The November issue brought with it an article that struck home to people in the gas business. Herbert O. Johansen's "How Your Gas Meter Works" tells the story,

New Success Program Gives You Short-Cuts to Executive Skills

AT AMAZING LOW COST—TAKES MINUTES A DAY!

Revolutionary New Monthly "Progress Kits" Develop the Abilities You Need to Win Faster Promotion, Increase Your Earning Power

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You start with a remarkable memory trainer. Then every 30 days you will receive a new self-training Progress Kit on an essential success subject.

There has never been anything like these "Progress Kits" available — for completeness, authority and detailed step-by-step guidance. Nothing has been left out. The expert business leaders, psychologists and educators who planned the Program have included all the know-how *and actual practice* you need. Their simplified new self-instruction method enables you to gain "practical experience" in the odd moments that now go to waste every day.

Sample "Memory-Trainer" Kit only 10¢

To introduce you to this new kind of personal achievement plan, Nelson Doubleday offers you a valuable "sample kit" almost as a gift. You'll receive a remarkable 10,000 word handbook — *How To Remember Names and Faces* — that gives you the secrets of professional memory experts. In the first five pages you'll learn one easy trick that will double your memory power — *overnight.* Soon your new "automatic memory" for names, faces, facts will win new friends, gain recognition on the job.

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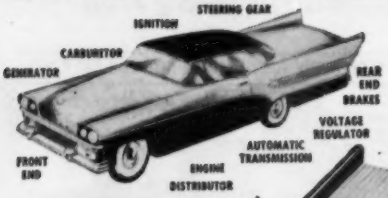

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I'M IN the market for some covers from your magazine. I want to use them on the walls of a room—instead of wallpaper. I've saved all my back issues for this purpose, but I'm still some short. Could I buy some covers only?

CHARLIE GRAHAM, Ottawa, Ont.

A few covers from spare copies are on the way.

PS Files Make Good Neighbors

I AM a real rooter for your Home Owner's Repair Section. Your "Materials File" on nails and your "Fix-It File" covering masonry stains [Aug.] came in very handy to me and my neighbor. As far as we are concerned, they were published at just the right time.

TONY SUROWIC, Chicago.

Missed Again!

IN OUR office we have a Bates stapler that's exactly what Ronald K. Hering wants ["I'd like to see them make," Nov.]. Our gun is of indeterminate age, but it's probably been around for at least 20 years.

If Mr. Hering is sincere, tell him we'll be glad to exchange ours for a new stapler (any type) and we'll throw in a spare spool of wire. He will be doubly rewarded, for if he holds onto it for a few years more he'll have an antique.

A. JAMES WALSH, Camden, N.J.

The Bates people reported in, too. They say their wire-feeding stapler is the most favored model abroad. Brand new is their electric stapler with two heads. Interchangeable, one whams out regular staples; the other makes its own from a roll of wire.

We Consulted the Sultan

THE solution of the "Brain Buster" [Nov., p. 101] was very clever. However,

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"Doing spare time repairs on Radio and TV. Soon servicing full time." CLYDE HIGGINS, Waltham, Mass.

"I had a successful Radio repair shop. Now I'm Engineer for WHPE." V.W.WORKMAN, High Point, N.C.

"There are a number of NRI graduates here. I can thank NRI for this job." JACK WAGNER, Lexington, N. C.

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the number of coins in each bag is never specified. Therefore, if any one bag had less than the number of coins required for weighing, the solution would be thrown off. That is, if the fifth bag contained only four coins, the bag with the shaved coins could not be found. Or suppose no bag contained more than nine coins? The solution is then unworkable also.

J. F. LiCausi, Farmingdale, N.Y.

Ah, but that was a wily sultan. He lined up the bags, took one coin from the skinniest bag and worked up to the plumpest one. Any collector who sent less than nine coins would have been executed anyway!

. . . I spent quite a few moments in meditation on the case of the crooked collector and was well pleased with my solution, although different from yours:

The sultan put 12 marked piles of coins—five from each bag—on the scale, and dropped in the penny. The scale registered 59 pounds, 11 ounces. Then he removed the coins, one pile at a time, until the scale read 25 pounds even, indicating that the seventh collector was the one who had short-changed him.

Don Bailey, Ottawa, Ont.

Another Way to Make a Buck

Detroit is a dizzy city and any male citizen that tells you he doesn't own the shirt on his back may be telling you the truth! We now have a laundry that rents out shirts by the week. You pay $1.95 for a delivery of five, 35 cents for each additional one. They're good shirts, too—worth about $5. You get the same lot every week; they're marked with your name.

L. T. Jonas, Detroit.

Just a Busy Little Pooch

That's a busy little dog you've got in December's "Wordless Workshop." In one picture he's shown chewing the mailman's left leg, but in the next picture the mailman's *right* trouser leg is torn.

Alan Dodd, Bay Village, Ohio.

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The month in science

Antifreeze vs. aluminum engines. The new lightweight engines are just about to bust out of the test labs (see p. 93), and Detroit is already worried about concocting an antifreeze you can pour into them that won't eat holes in the radiators and cooling jackets. Leonard Rowe of GM Research bluntly told chemical manufacturers to get on the ball "or alternative methods of cooling will be found."

Aluminum is a reactive metal, even if it doesn't "rust" like iron. Corrosion problems will be different. Rowe listed two that "are sure to be more prominent":

- Pitting—the tiny holes that you sometimes see eaten into your wife's aluminum cookpots.
- Galvanic corrosion—small electric currents flowing between the aluminum and other elements that touch it. Actually, a weak electric battery is formed, with the aluminum serving as one electrode which dissolves to provide the current.

These and other troubles can presumably be licked with the right inhibitors. Problem is to find them—fast.

Interplanetary weather report. How cold is it on Venus? Does it rain on Mars? Earthbound scientists have compiled remarkably detailed accounts of what it's like way up there.

Venus. It's always cloudy. That's why Venus shows up so bright in the sky as the Evening Star. Even though the clouds (probably dust or some carbon-oxygen compound) block any view of the surface, radio measurements and studies of infrared spectrograms give an inkling of the temperature: It's beastly hot, averaging 100 to 200 degrees F. or more.

Venus' atmosphere is unappealing to Earth-type people. It contains 500 times as much carbon dioxide as we have, but less than a twentieth as much oxygen and water vapor. There seems to be a fair amount of nitrogen.

Mars. Cool and hazy with occasional scattered clouds. The haze is blue, apparently caused by a thin layer of very tiny ice crystals 25 to 30 miles up. The other clouds are like ours, and there are ice fogs at night.

The Martian atmosphere is extremely thin (pressure less than a hundredth of Earth's). Most of it is nitrogen, but there's 10 times as much carbon dioxide as we have—and no oxygen. Astronomers can see snow, which means water; but the air is so dry that liquid water can't last and snow evaporates without melting.

The temperature—in the daytime—is Earthlike: near 90 at the equator, 80 below at the poles. But those cold Martian nights! It gets down to 200 below even at the equator. (Reason: Mars' dry atmosphere provides little greenhouse effect, the way ours does, to keep heat on the planet.)

Jupiter. Rough clouds, bitter cold—and poisoned air. The clouds that cover Jupiter are frozen ammonia. Ammonia gas and

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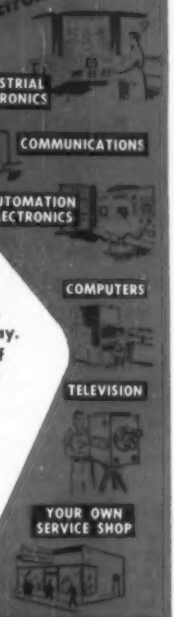

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methane gas—both of which kill people—are present in the atmosphere. Most of the air, though, must be hydrogen and helium, the lightest gases (scientists deduce that from the shape, gravity and rotation of Jupiter, which call for a heavy planet with a deep atmosphere of extremely light weight). Jupiter's temperature is as impossible as its atmosphere: 180 below zero.

One weird puzzle on Jupiter is the Great Red Spot, an oval 25,000 miles by 8,000 miles that is usually brick red but occasionally turns white. The Spot could be a mountain area—like Earth's Tibet—sticking through the clouds (a fall of ammonia "snow" would turn it white). The trouble is, it shifts around on the planet as though it were a floating island. And what solid substance could be light enough to float in an atmosphere of hydrogen and helium?

The other planets? Seymour L. Hess, Florida State University meteorologist who compiled these facts for a recent report in the journal "Science," says that Mercury lacks an atmosphere; Saturn, Uranus and Neptune are just like Jupiter; and Pluto is so far away we don't know much about it. He remarks that none are inviting locations for Earth colonies.

Negative weight. Four RCA researchers have found pieces of ordinary matter that act as if they fall up. Some pieces are electrons —the very lightweight electrified particles that are part of all materials—inside germanium, the metal transistors are made of. These electrons get kicked the "wrong way" by radio waves, as if their mass were negative.

The scientists also turned up negative-mass "holes." Holes are spaces in a material where electrons ought to be but aren't. They move through the material (the way empty parking spaces move in a lot when cars come in and out), carrying positive electricity—they are the opposite of electrons, which carry negative electricity. Ordinarily, holes act as if they had positive mass, like ordinary electrons.

This startling discovery does not promise a new kind of antimatter, repelled by earth gravity (such "contra-terrene" is believed to exist, but in worlds outside our own). One physicist compared the negative-mass electrons to pieces of wood observed by an underwater swimmer; if the swimmer didn't know about buoyancy, he would think that wood rose to the surface—defying gravity—because of negative mass.

One possibility: Electrons in solid materials may always act that way, as if their mass were negative, while electrons in a vacuum (we know more about them) act the other, ordinary, way. Practically, the negative mass might be put to work in new kinds of amplifiers.

Could you be hypnotized? Well-adjusted, popular and active people are easiest to hypnotize—and women are twice as susceptible as men—reports Prof. E. R. Hilgard of Stanford.

Martin Mann

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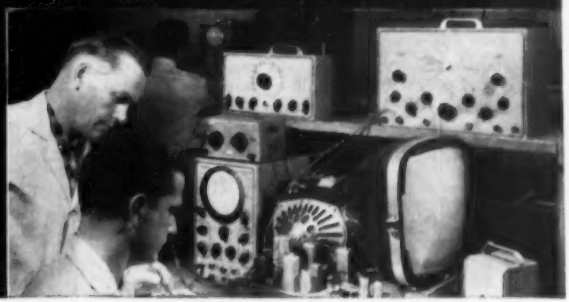

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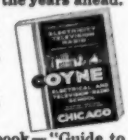

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The firm of McMorrow, Berman & Davidson, with offices in Washington, D. C., is qualified to take the necessary steps for you. We can make a preliminary search on your invention, advise you whether we think it can be patented, and prepare your application for patent.

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You ought to know...

Re-tire with wire? Hottest thing on the tire industry's research griddle is the tire with wire instead of rayon or nylon. Truckers have been using them for a long time. Now they may be on the way for car owners, too.

Biggest bump they still have to hurdle: comfort. They give a rough ride—okay for sports-car fans but sure tc be vetoed by Detroit. The problem is frustrating to engineers because the same wire tire is cat's-paw soft on a truck—truckers, in fact, say it reduces maintenance costs by lessening road shock. Reason seems to be the weight difference between car and truck. Some arguments for wire:

- They're blowout proof. Firestone sold Greyhound buses its costly four-ply wire tire for front wheels. Result: no blowouts in 120 billion miles of service.
- Better tread wear. One coast-to-coast trucking company using a single-ply job says tread wear averages 10,000 miles per 1/32 of an inch—100 percent better than conventional tires.
- Servicing required: none.
- Traction is superior because of the tire's flexibility. It may be the answer to the perfect tubeless tire.

So far Goodyear and Firestone make single-plies for trucks under Michelin (of France) patents. Both reinforce the area under the tread with breaker strips. But they're unhappy with Michelin's passenger-car types. U. S. Rubber played around with a multi-ply wire tire a few years ago, now is plunging deeply into developing its own single-ply to avoid Michelin's patents.

Plugging along with conventional nylon, Du Pont is pushing research for a two- rather than four-ply tire. Fabric would be heavier. Advantages: They'd run cooler, wear longer, be free of "flat spotting" (that morning thump) . . . maybe cost less.

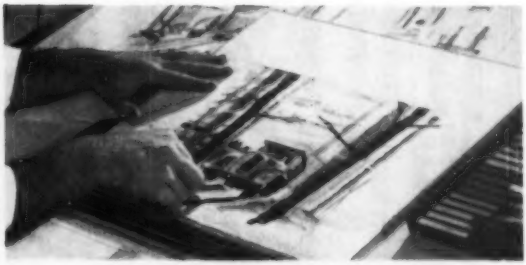
Car-less kids, keener scholars. An Idaho high-school principal studying the grades of students with and without cars over a four-year period came up with the following thoughts-for-parents: No student who maintained an A average over the period had the use of a car during school hours. Only 15 percent of the B's did. 41 percent of the C students drove to school, while 71 percent of the D's had cars. Of those who failed completely or quit school, 83 percent had access to cars during school terms.

February is the cruelest month for your car. Some timely suggestions:

- A slapping cross link on skid chains should be repaired or wired back. The flailing links may chip off the protective coating inside a fender and encourage future rusting.
- Beware bare roads with snow piled high on the sides. There's always the unexpected melt that slithers across and slicks over.
- Rock 'n roll your way out of snow drifts—rhythmically, with the

New talent needed for commercial art

Magazine illustrating



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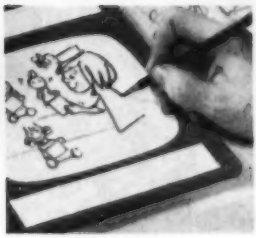

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Art Talent Hunt announced by nationally known illustrator

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Artists are needed in every branch of commercial art – advertising illustrations and layout, poster work, television art, magazine illustration, cartooning, and other fields.

Over $10,000,000,000 is being spent this year for advertising alone – much of that for art. You can see why new talent is needed.

Openings in art have increased about 50% in the last five years, according to a large employment agency. In every part of the country, there's a big and growing need for new art talent. That's good to know!

Earnings up. Today, commercial artists are being paid more and more highly. Many are now earning from $150 a week to over $50,000 a year in art.

If you like to draw, you may have enough talent to succeed in commercial art. Here's the first thing to do. *Find out* if you have the necessary talent. You can, right now – without cost or obligation.

Take Talent Test at home. This Art Talent Test is being contributed free – during the Talent Hunt – by a well known art school to help fill the nationwide need for new artists. It's a simple test, yet it will tell whether you were born with a natural talent at drawing.

You take this test by yourself, then mail it back. Professional artists examine and grade it — and if your test shows talent, you will get skilled counsel and guidance about a rewarding career in art.

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least amount of wheel spin. Many an inept driver will race his engine and promptly dig deep troughs that chock rear wheels.

- Recheck non-permanent antifreeze if you do any trafficky driving on a warmish day. Some antifreezes lower the boiling point to a level where it's easy to lose protection without realizing it.
- Icy ruts are wicked on front-wheel alignment. If drive you must, gentle your front end by being light-fingered on the wheel and keeping the speed down.
- Protest when maiden aunts want the windows closed. That inch from the top is doubly important: It protects you from carbon monoxide seepage and it keeps you safe from the sluggish effect of dry car heat.
- Between daylight and dark are the danger hours—any time of the year. In winter more accidents occur between five and six p.m. than at any other time. So be careful. You're not aware of the adjustment your eyes make as the "night is beginning to lower."
- Top of the list of major car sinners is the man who races a cold engine. Warm it gently; drive off slowly.
- But you can get engine heaters to hasten the warm-up a little. Both coolant-heating and oil-immersion types are available. The coolant variety puts a heating element in the water jacket, plugs into any 110-120 AC or DC outlet. The oil kind works by replacing the dipstick with a heating element. Price is around $10 for the coolant heater, $3.50 for the slower (but simpler) oil type.

Tired? Listless? Out of sorts? See your doctor instead of reaching for an alfalfa pill. The American Medical Association, the Food and Drug Administration, and National Better Business Bureau have combined forces to combat food faddism. Here are some pitches debunked in "Today's Health," the AMA magazine:

- Most disease is due to improper diet. Nonsense. Diseases due to dietary deficiencies are rare in the U. S.
- Soil depletion causes malnutrition. No. If essential soil elements are lacking, the plants won't grow.
- Chemical fertilizers poison the land. The fact: Government research shows no significant effect on nutritional value of crops due to the soil they're grown in or the chemicals used.
- Wonder foods: Molasses, whole-grain cereals, honey, raw vegetables—sure, they're good—but not the be-all and end-all of nutritional existence.
- Aluminum pots and pans destroy food value. An unqualified no. Hospitals everywhere use them all the time.
- Processing destroys nutritional quality. Not these days. Foods are canned or frozen at peak of nutritional perfection.
- "Subclinical deficiencies" are a constant danger. This is jabberwocky. But if a "worn-out feeling" persists, it may be the forerunner of serious disease.

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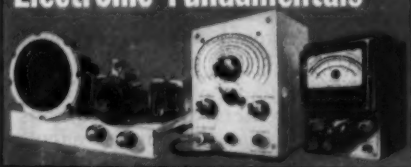
RCA INSTITUTES

course I

Electronic Fundamentals



course II

Television Servicing

course III

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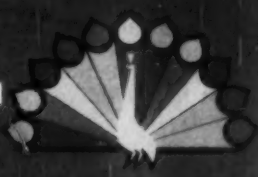

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- The atmosphere 200 to 2,000 miles high was proved denser than had been thought.
- The sun was found to emit X rays that black out radio by generating an electrically ionized layer in the upper atmosphere.
- The electrojet, an electrical current that circles the earth high in the atmosphere over the equator, was discovered and mapped. Together with similar currents circling the poles, it may be the cause of changes in the earth's magnetic field.
- The South Pole, almost 10,000 feet above sea level, turns out to have 9,000 feet of ice beneath it. It may be that Antarctica is not, as had been thought, a solid land mass at all.
- An undersea mountain range was discovered in the Arctic Ocean. Much information about the cold waters, as well as the earth's shape, was obtained when two nuclear submarines sailed under the Arctic ice.
- Oceanographers discovered a counter-current under the Gulf Stream off the east coast of the U.S. Another counter-current, called the equatorial undercurrent, was found flowing from Asia toward Panama in the equatorial region. It carries a billion cubic feet per second, about 1,000 times as much water as the Mississippi River does.

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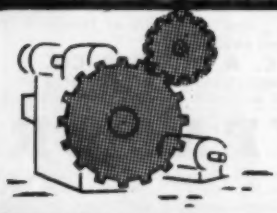

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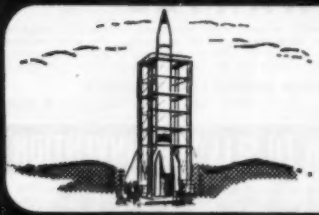

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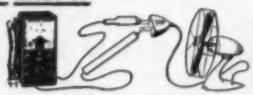

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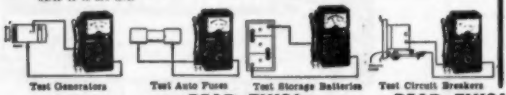

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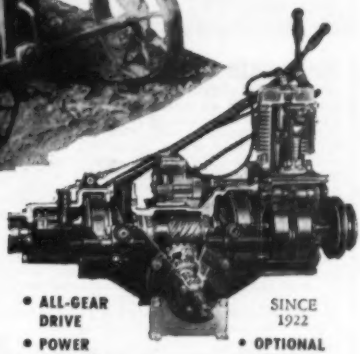

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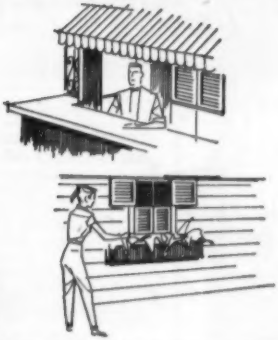

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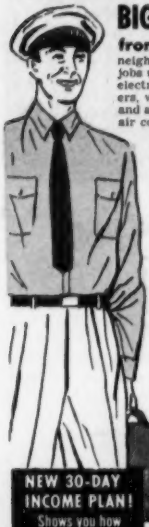

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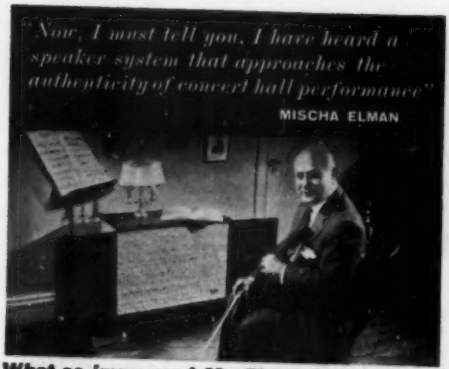

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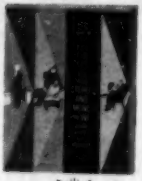

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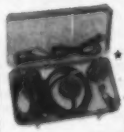

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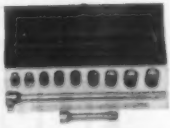

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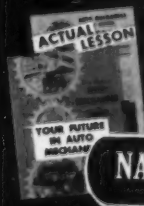

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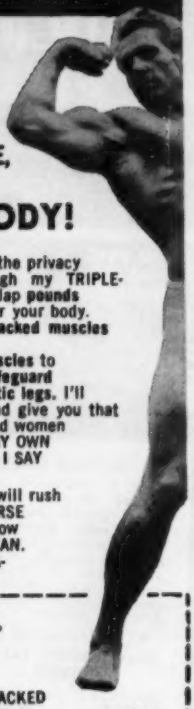

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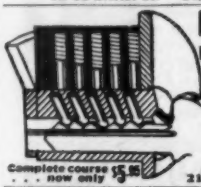

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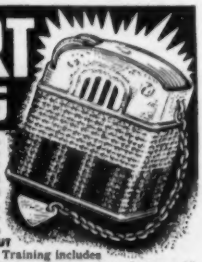

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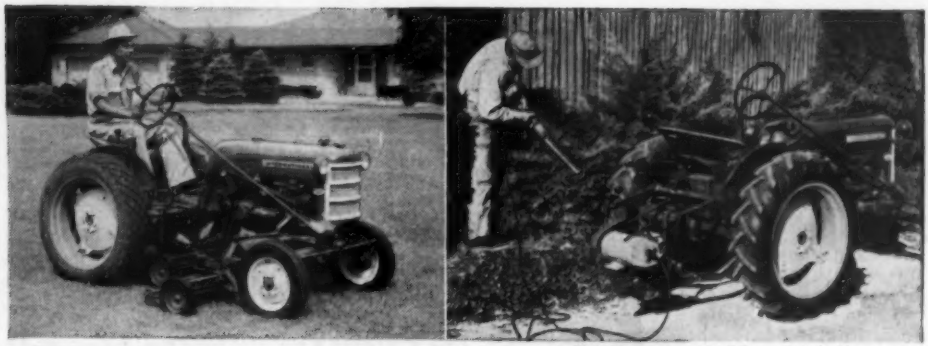

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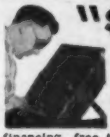

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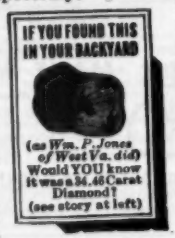

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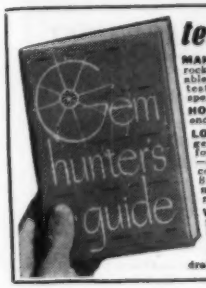
- A Diamond weighing over 20 carats was found in Va.?
- A vast region surrounding the Great Lakes holds the greatest store of Diamonds yet to be found in the U.S.?
- Gem sapphires are found in Colorado, Idaho, Montana, and North Carolina?
- For every diamond already found in this country, there are thousands more yet to be found?
- A cowboy found an Opal worth $280,000.00?
- Mid-west streams have produced as much as *half a million* dollars worth of pearls in a single year.
- 10-pound Turquoise nugget, believed largest ever found, discovered recently in one of our western states?
- Valuable Gems are discovered in all parts of the U.S.—even in New York City area?



tells you:

MANY WAYS to test rocks to see how valuable they are: the color tests, hardness and specific gravity tests.

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WHERE rubies are found in Georgia, Idaho, New Jersey and No. Carolina

How to make the drab rocks glisten like magic with "black light"

HOW TO IDENTIFY over 75 different gem materials by hardness, composition, color, luster, cleavage, associated rocks, etc.

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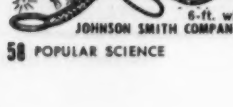

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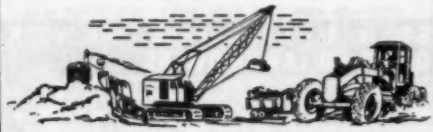

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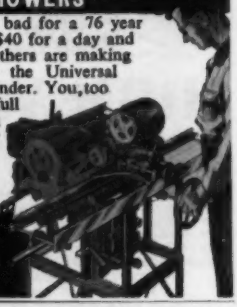

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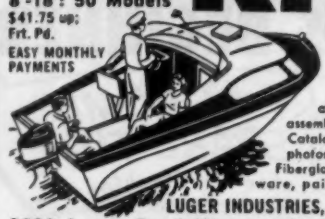

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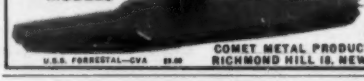

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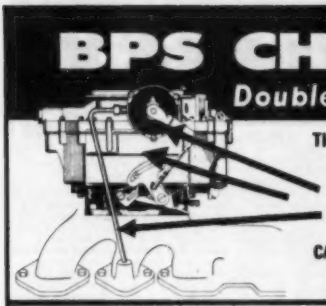

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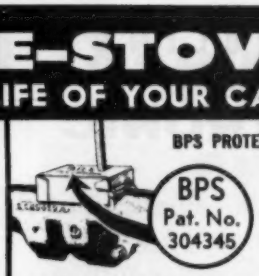

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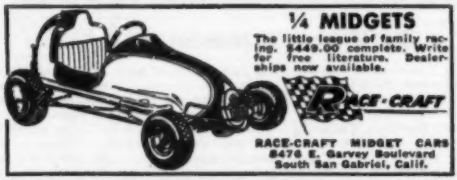

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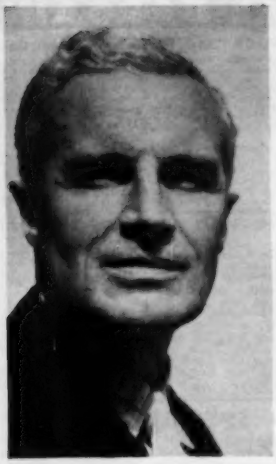

I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things; of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life, is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows". It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own". It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

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In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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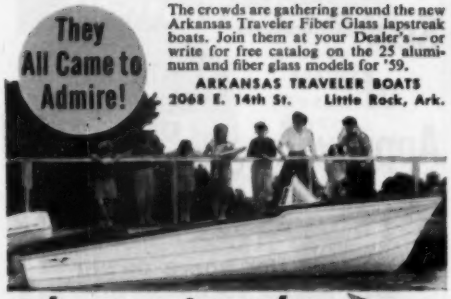

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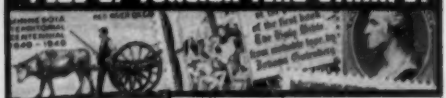

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The Man Who Tamed the Automobile

FROM the balky horseless carriage that had to be run by an "engineer" to the smooth living-room-on-wheels driven by women—the evolution of the modern automobile paralleled (and was shaped by) the career of one remarkable man, Charles F. Kettering, who died last fall. He was probably the last of the great inventive geniuses in auto development.

Kettering passed himself off as a homey "screwdriver and pliers engineer," but this may have been largely to express his distaste for erudite phonies, the kind of men who, in his words, said, "You can see through glass because it is transparent." He looked the part: lanky and stooped, with a long, bony face.

NOW EVEN WOMEN COULD DRIVE: Historic photo shows Boss Ket adjusting one of the first self-starters, which he developed for Cadillac in 1910.

In reality, Boss Ket was no farm boy turned tinker. He had a solid formal education (Wooster College and Ohio State), and more important, the alert, curious, open mind of a true scientist. (He was also a regular reader of POPULAR SCIENCE.) In his most famous invention—the starter—he demonstrated all these qualities.

Kettering was then partner in a successful patent laboratory, Dayton Engineering Laboratories Co. (Delco), which had developed and sold to several car manufacturers a battery-ignition system. Cadillac was one customer.

When a friend of Cadillac president Henry Leland was killed cranking a car, Leland urged Ket to work up a starter.

Kettering knew that a small electric motor could do a heavy job if it only had to work briefly, an obvious fact overlooked by other enginers who couldn't get out of the rut of thinking about constant-duty trolley motors. He had used the same basic idea years before to develop an electric drive for cash registers. So Kettering provided gears that quickly disconnected an undersized motor from the engine it cranked.

Kettering's starter was a success, but not until some soap-opera melodrama had intervened.

Ket broke his leg testing an experimental car. Then the only starter-equipped Cadillac was damaged in a fire at the Leland garage in Detroit. Kettering, leg in a cast, left his sickbed, traveled from Dayton to Detroit and put the scorched car and starter back on the road.

He went on to supervise auto development for 40-odd years, first independently and later as GM's long-time research chief (he called himself "consulting inventor" to General Motors). His men developed Ethyl fluid (engine knock had been blamed on Ket's ignition system by the magneto advocates), quick-drying lacquers, the modern two-cycle diesel engine, and air-cooled compressors and Freon gas for home refrigerators.

Kettering was a vocal proponent of cut-and-try research. But his cut-and-try methods required very sophisticated scientific knowledge and planning. You can get the idea from his own account of the way Thomas Midgeley discovered Freon refrigerant:

"Midgeley said of the work, 'We plotted the boiling points, worked slide rules, brushed away eraser dirt and pencil shavings and did all the other formalities that take the place of tea leaves and crystal balls in the life of a scientific fortune teller.'

"After this had gone on for a long time, the search focused on one compound which . . . they called F-12."

Kettering contributed fortunes to fundamental research on photosynthesis (he called it research on "Why the grass is green") and cancer.

But the breadth of his interests is best typified by his election as president of both the Society of Automotive Engineers and the American Association for the Advancement of Science.

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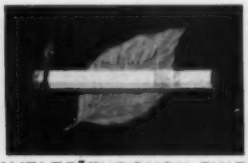
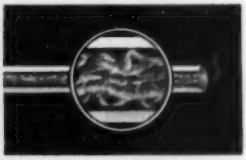

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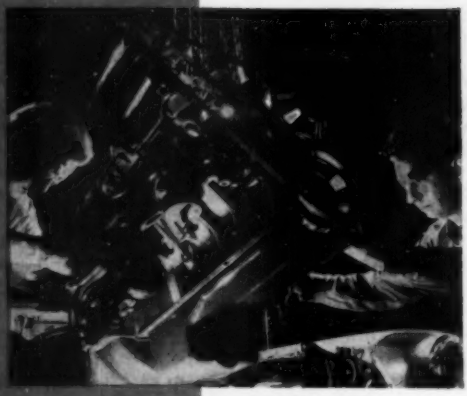
Here Come ALUMINUM ENGINES



They'll let an auto owner have his cake and eat it too: a big car, with even more zip, better road handling, many more miles per gallon. Yet aluminum-engined cars will carry lower price tags

By William Carroll

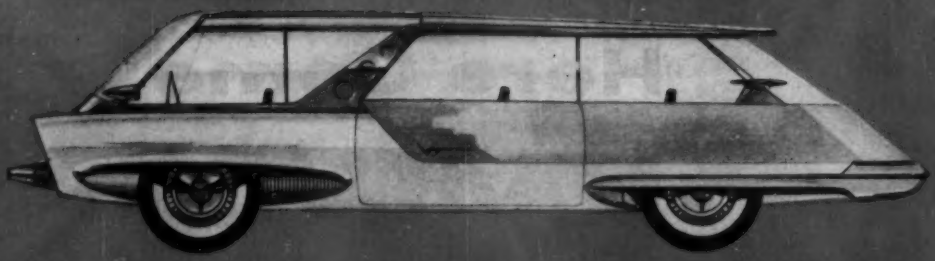
ALUMINUM engines are leading Detroit's biggest engineering shakeup since the V-8 came marching in. The only practical answer to the increasing public rumble for more economical—but spacious—cars lies in drastic weight reduction.

Engine designers lost ground during the trend to larger and heavier cars. The big power plants, even though more efficient by specific measurements, haven't kept pace. The average driver's gas mileage fell from 17 miles per gallon in 1950 to 14.2 miles per gallon six years later.

Iron engines represent the largest single weight mass in modern cars. An all-aluminum engine in a new car would use 200 pounds of light metal, but it would eliminate a total of 400 pounds of iron on the engine alone. Pull 400 pounds off a 1959 sedan and hill climbing becomes 50 percent faster, and gas mileage improves in nearly the same proportion. Moreover, tires and brakes last longer under lighter cars.

How soon are they coming? Motor makers, always sensitive to the sale of the current product, will say little. But knowledgeable Detroiters believe that the first aluminum

These designs show what all-aluminum cars might be like

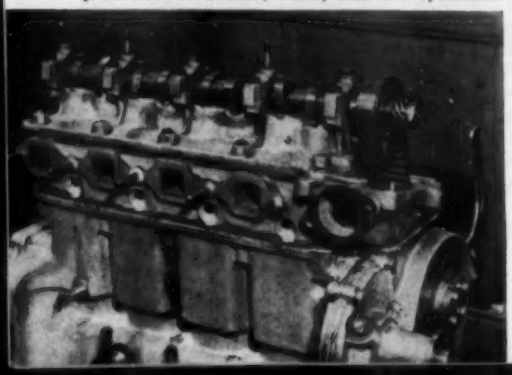


A family of specialized dream cars designed by Kaiser Aluminum includes a station wagon (above) and two-door sedan (right). Maximum utility would be achieved in the wagon by seating its driver directly over an aluminum engine. Front-wheel drive eliminates the usual tunnel, permits a flat aluminum floor suit-

engines may be as near as the Fourth of July. First units will most likely show up in a panel truck (low-volume truck production gives time to whip new problems). General Motors trucks, with their expected flat six, will be kept close to GM service centers so that the engine can be "de-bugged" before release in the "Chevrolittle"—the sleek, not so hush-hush rear-engined Chevrolet.

Are aluminum engines new? Far from it. The Aluminum Company of America (Alcoa) built one in 1917. In 1940, Ford made 95-hp. aluminum engines for light-plane use. Chevrolet has been testing light-metal power plants for 20 years. Aluminum duplicates of Pontiac's 1942 six were shown to automotive designers. In 1952, GM patented a 335-hp. aluminum V-8 developed by Buick. The 1958 Sebring Corvette had a 300-horsepower V-8 in which all but the block was made of light metal.

THIS EARLY ALUMINUM ENGINE started all the fuss. The four-cylinder, 28-lb. block was sand-cast by Kaiser. A later die-cast version, first produced in March, 1955, had six cylinders.



Why the sudden fuss, then? Detroit has long been stymied by weight. Power accessories reduce gasoline mileage and performance; weight has gone up with size; and cars have become too expensive. Aluminum seems to be an answer. Plentiful raw materials cover a twelfth of the earth's surface, and processed aluminum is getting cheaper every year as production facilities expand. Auto engineers claim that aluminum engines, and *the lightening of the chassis thus permitted,* will help cut production costs. Which is another way of saying that lighter cars could be less expensive.

What's held them up so long? Designers know that lightness means economy. But one big headache is aluminum's expansion at increased temperature, about three times that of cast iron. A temperature rise of 200 degrees can cause aluminum bearing webs to expand .006 inches; an iron crankshaft journal expands much less, which means that bearings become noisy and lose oil pressure. The drawback can probably be "designed out" but it won't be easy. Another problem: Aluminum pistons and cylinder walls wear rapidly if made of conventional alloys. Chrome-plated cylinders wear better but the cost ($4 each) takes chrome out of the ball game. Spraying iron inside aluminum cylinders figures at $2 a bore; liners, tubes of hard metal inserted into the block, are equally expensive. General Motors is testing engine blocks of silicon-aluminum alloys; they wear like iron and require no liners or coatings. But silicon

able for front- and side-facing seats, fold-away beds or cargo. Access to the driver's seat is through a hinged front door-windshield and two rearward-sliding roof sections. The aluminum-bodied sedan is powered by an air-cooled aluminum engine in rear. Structural-glass windshield and a rear aluminum post support roof.

alloys are expensive and hard to cast.

Are there production problems? Plenty. Management's most serious problem: Should aluminum engines be cast in sand, permanent-molded, or die-cast? Few engineers consider sand casting aluminum sensible because substitution of aluminum for iron increases the cost of a raw block and eliminates no succeeding machine operations. Some manufacturers, however, may have to use their iron foundries in production of aluminum engines, for reasons of economics. This limits them to permanent-mold castings.

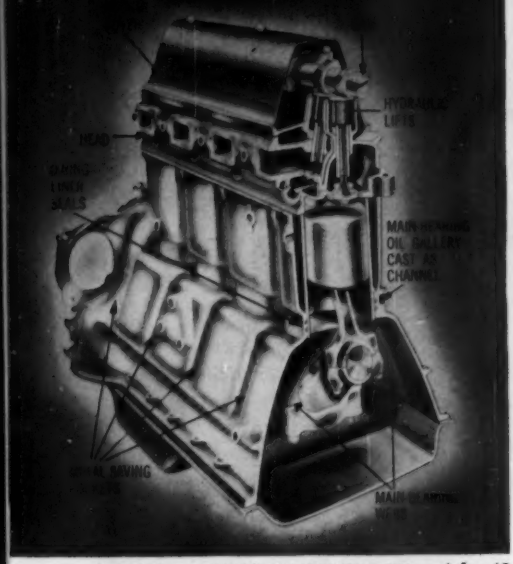
Though it takes a half-million dollars and up for die-casting equipment, foundry men happily point out that die-cast blocks eliminate costly machining—they're almost ready for assembly after trimming the edges. Their favorite example is Chevrolet's 11-pound Turbo-Glide-transmission aluminum case. It's die-cast in 60 seconds, including intricate oil passages that would have to be separately drilled on an iron casting.

Will they be expensive? No. They'll be cheaper, even though aluminum costs more per pound than iron. There is almost three times as much aluminum as iron in a pound of each metal. Six V-8 engines are cast from a ton of iron while nearly 16 engines can be cast from a ton of aluminum. Car makers who ship engines to assembly lines all over the country will enjoy a reduction in transportation costs because 100 aluminum engines can be shipped for the cost of 40 iron engines.

Dollar-and-cents figuring at GM and Ford begins with molten aluminum from a reduction plant, delivered to the foundry next door for about 22 cents a pound. The foundry would spend another two or three cents casting this hot metal into aluminum blocks. Result: a 75-pound aluminum V-8 block for $19, plus a small percentage of the investment in casting machinery. For comparison, today's 225-pound cast-iron V-8 block costs about $22, to which must be added overhead for foundry equipment plus the necessary machine tools to trim, drill and bore it before assembly.

Will they be like iron engines? They

AN ENGINE FOR ACCESSORIES, this 53-pound aluminum two-cylinder job is tucked into the nose of GM's Firebird III. It puts out 10 hp. at 3,600 r.p.m., and runs generators and pumps.



RECENTLY DESIGNED ALUMINUM SIX weighs 43 pounds—130 lbs. lighter than gray iron. "Wet" sleeves are pressed into the bores and sealed against cooling water with rubber O-rings.

may look much the same. But instead of wearing 75-pound cylinder heads, the heads will be light 30-pounders. Blocks will be a couple inches shorter because aluminum passes heat so rapidly that engineers can eliminate part of the water jacket and build cylinders next to each other, with pistons separated by a quarter-inch of metal. Smaller radiators, for reduced volume of coolant, mean smaller fans absorbing fewer horsepower and using lighter fan belts.

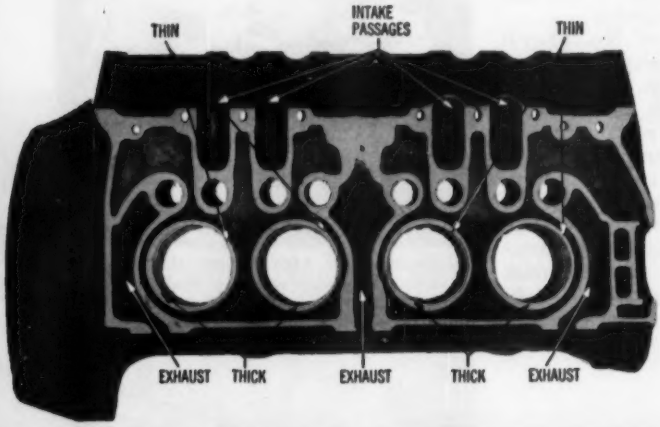
Other differences for the new engine might be water and oil galleries cast as open areas, later covered by aluminum plates; removable cylinder liners; aluminum connecting rods; and separate camshaft bearings.

How will chassis design be affected? Nearly 600 pounds of iron or steel parts in the average American car might be produced in lighter metal. Aluminum wheels and suspension members could reduce shock forces jarring the car body by 50 percent. The engineer's "rule of thumb" saving is: "One pound of aluminum replaces two pounds of iron."

Will the cars look different? Definitely! Aluminum engines can be smaller than iron engines of identical horsepower. Smaller engines use smaller radiators, which allow lower hoods and better forward vision. Not to mention the possibility of light aluminum engines filling the trunk of something else besides imports.

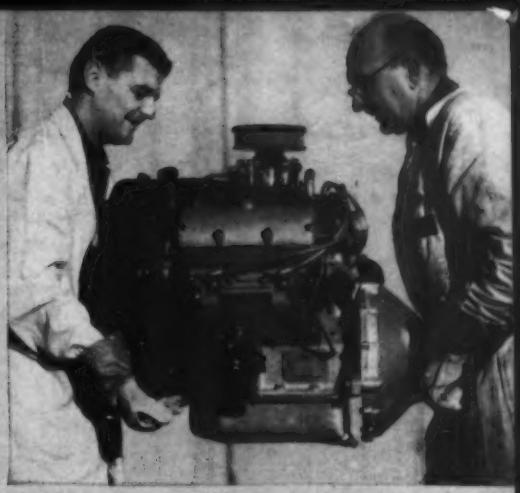
Will they be more economical? They can't miss. Economy gains will not become spectacular, however, until cars become 500 or 600 pounds lighter. Consider a 1930 Chevrolet six sedan: It weighed 2,700 pounds, had one horsepower for 50 pounds of car, and at a steady 50 m.p.h. went 16 miles per gallon of gas. By contrast, a 1958 Chevrolet six weighs 3,600 pounds and gives 20 miles per gallon at 50 m.p.h., partly because the horsepower-to-weight ratio is now 24 pounds per horsepower. But if the 3,600-pound Chevrolet were lightened to 3,000 pounds, fuel economy could jump to nearly 26 miles a gallon. A six-mile-per-gallon gain for everyone would trim the American gasoline bill three billion dollars a year.

Surveys suggest that two-thirds of our present miles are spent on traffic driving, where the car is either gaining speed or braking. Pounds off means less weight to start or stop every few moments, from



EVILS OF IRON: This conventional cast-iron block has been cut apart to show defects common in sand casting. Cylinder walls, supposed to be of uniform thickness, actually vary from very thick to dangerously thin. This causes uneven cooling. Trouble comes from core-shifting during casting process. Die-cast aluminum blocks can be held to 1/100 inch of the exact design.

Will a V-4 Like This Power a Future Light Car?



American Motors is already producing some aluminum engines for the armed services. They are V-4s, with two banks of two cylinders set at 90 degrees. Horsepower is 56 at 3,600 r.p.m., and the torque 90 pounds-feet at 2,000-3,000 r.p.m. The engine is air-cooled.

Dimensionally, it's tiny—roughly a two-foot cube. Bore and stroke are both 3.25 inches, and the displacement is 108 cubic inches. The compression ratio is low—7.5:1. Weight, without electrical equipment, is 214 pounds.

The engine produces .52 horsepower per cubic inch, which is less than that of present auto engines. American Motors explains it by the necessity of keeping the compression ratio low and the torque output high in military vehicles. Horsepower output could be pushed to .6 per cubic inch and beyond, engineers say, without difficulty.

A V-4 engine, here chosen for compactness, is no novelty. They are widely used in stationary and industrial installations. The V-4 has not been popular in passenger cars because it is more expensive to make than the in-line. The in-line, for instance, requires two cranks or "throws" in one plane, the V-4, four cranks in four planes.

The engine is not, of course, all aluminum. These parts are made of aluminum: block, crankcase, timing cover, cylinder heads, cylinder-head covers, and intake manifold. The exhaust manifold, connecting rods, crankshaft, valve train, timing gears, flywheel and fan pulley are made of iron or steel. Cylinders are made of die-cast porous aluminum so the metal will absorb and retain oil to cut friction. They are chrome-plated to reduce wear. Piston rings, of iron, are unplated.

Of the aluminum used, about 90 percent is the pure metal. The sand-cast parts—which include everything except the die-cast cylinders—contain from 1 to 1.5 percent copper, .6 iron, 4.5 to 5 silicon, .5 manganese, .4 to .6 magnesium, .3 zinc, .2 chrome and .2 titanium. Most of these are hardening agents.

This air-cooled aluminum engine has proved to be more efficient thermally—it makes better use of the heat energy it develops—than a water-cooled engine would be. That's because cylinder-head temperatures can be run at 400 to 435 degrees F., far beyond those of a water-cooled engine.

which will come an estimated 50-percent improvement in downtown fuel economy. Lighten that lump of vibrating metal between the front wheels and balance is restored so better handling becomes possible.

What's Detroit doing about it? American Motors is officially silent when asked about aluminum engines for passenger cars. But in 1954, George Romney, president of American, said: "In years of experimentation with smaller cars . . . we developed a powerful die-cast aluminum air-cooled engine." Two years later Mr. Romney mentioned the same engine as being one of a "family" that could be produced in units of two, four, six, or eight cylinders, either V-type or pancake.

Chrysler engineers say, "Sure we have aluminum engines . . . as part of engineering programs rather than publicity ones." Outsiders claim that Chrysler jumped for the bandwagon soon after seeing Kaiser's experimental block years back. Cylinder liners and wear-resistant alloys were tried in sand-cast aluminum V-8s during 1955 and 1956.

Today's busiest men at Chrysler are engine designers, reported hard at work on a water-cooled aluminum six with over-

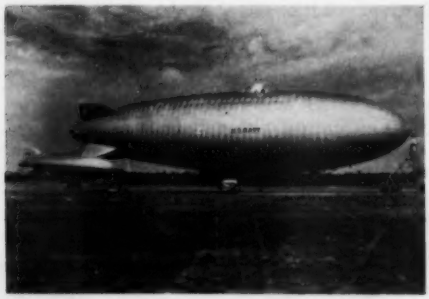
[*Continued on page 280*]

Plastic-bubble phone booth

NEW experimental design by Bell Telephone Labs, this transparent-plastic bubble dome in an aluminum frame would be used in protected areas such as a railway concourse. It has a standard desk phone.

160,000 times life size

THIS electron microscope, said to be the world's most powerful, makes a hair look 15 feet thick. U.S. Steel employs it to study strength and ductility of metals in development of better steels.



Biggest blimp; biggest antenna

THE Navy's new ZPG-3W blimp, world's largest, conceals in its 1,500,000-cubic-foot bag the world's largest revolving airborne radar antenna. It was built by Goodyear for early warning at sea.

Fountain glows under dome

FLUORESCENT lamps shining through a translucent green dome impart vivid color to the Orlando, Fla., memorial fountain above. The dome, 60 feet across by 18 high, contains 200 sheets of plastic.

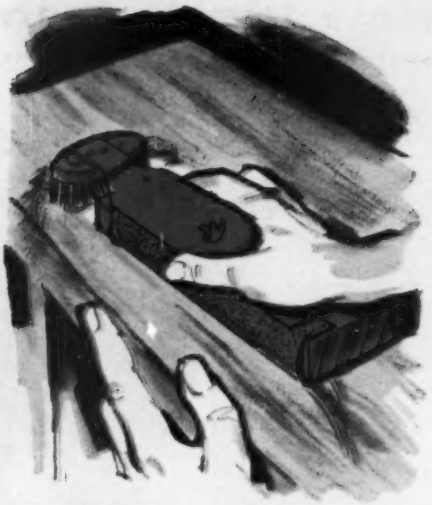
New Ideas from the Inventors

1 Drop Cloth Fits on Ladder. With this recently patented, off-the-floor drop cloth on your ladder, ceiling jobs should go faster, cause less clutter, and cut down furniture moving. Supported by corner poles, the upside-down tent would catch drips and scrapings over as wide an area as you could reach from the ladder.

2 Clear Cream Cures Trim Troubles. A shaver could see just where to trim sideburns, mustaches or whiskers if he lathered up with this transparent, brushless cream. Skin blemishes that should be avoided by the razor would also be visible under the colorless preparation.

3 Travel Alarm Clips on Door. A prowler would announce himself just by turning the knob of any door to which this alarm was attached. The portable unit, held by suction cups, would protect against hotel thieves and the like; other models could be screw-mounted on doors or windows.

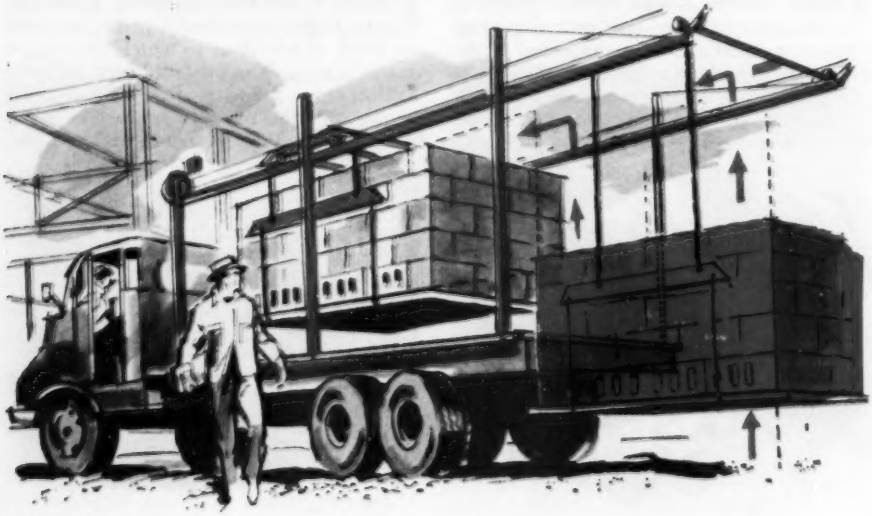
Please turn the page for more new ideas

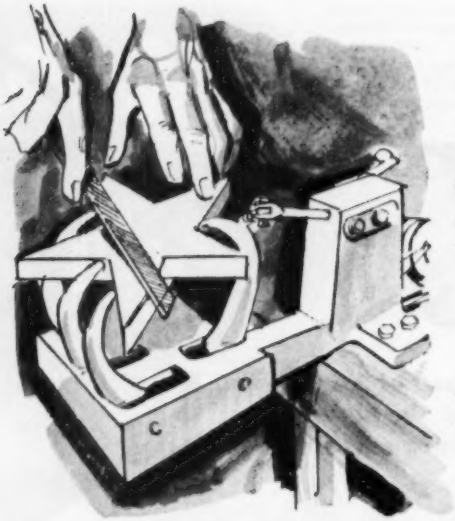


4 Saucer Stops Coffee Drips. The raised, dimpled center of this saucer would drain slopped liquid away from the bottom of a cup and thus keep clinging drops from dripping onto you. The rim of the saucer would also be raised so spills wouldn't be likely to overflow.

5 Sanding Block Cleans Own Swath. A brush on the end of a sanding block would let you keep your work area clear with hardly a wasted motion. By eliminating the dust that impedes cutting action and clogs abrasives, it should also speed a job and stretch sandpaper life.

6 Hydraulic Track Loads Trucks. Suspended by pulleyed cables from this traveling carriage, heavy loads could be easily raised, lowered, or shifted by engine power delivered through a hydraulic pump. Overhanging the truck, the carriage could handle crated or palleted cargo from ground level or from a loading dock.





7 Finger Vise Grips Odd Shapes. Independent, spring-tensioned fingers on this mechanical hand, which could be padded for delicate work, would hold irregularly shaped objects more securely than a conventional vise. A pedal would spread the fingers to release the work.

8 Umbrella Window Is Shielded. Clear, see-through windows in an umbrella don't let you see much, says this inventor, when they get blurred by rain, sleet or snow. To improve visibility, he'd add a separate shield above the clear panels. Like the main cover, it would be supported by pivoted ribs that would be raised or lowered by moving the collar.

9 Wrist Counter Adds Food Bills. A shopper might be better able to resist budget-busting supermarket sprees if she could keep tabs on total purchases as she made her rounds. This wrist adder would register the total as she dialed the cost of each item. Prefiguring would also serve as a check on cash-register addition.

The following patents *have been issued on these inventions: 1. Patent No. 2,755,009 to A. Parker, W. Palm Beach, Fla.; 2. No. 2,833,693 to G. Naimark, Cleveland; 3. No. 2,760,460 to E. Short, National City, Cal.; 4. No. 2,755,644 to E. C. Watson, Roseburg, Ore.; 5. No. 2,760,217 to A. McKenzie, Dorchester, Mass.; 6. No. 2,751,095 to H. L. Haverstick, Manheim, Pa., and H. C. Haverstick, Lancaster, Pa.; 7. No. 2,846,906 to J. Hill and E. Nuckols, San Antonio, Tex.; 8. No. 2,841,160 to A. DeVispelere, Syracuse, N.Y.; 9. No. 2,845,226 to H. Cummings, San Diego, and H. Doucett, Escondido, Cal.*

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

New Small Car Runs on Electricity

Speed: up to 58 m.p.h. Power: a pair of 2½-hp. motors. Noise: a faint whine. And one battery charge takes it 80 miles on 18 cents' current

By Wesley S. Griswold

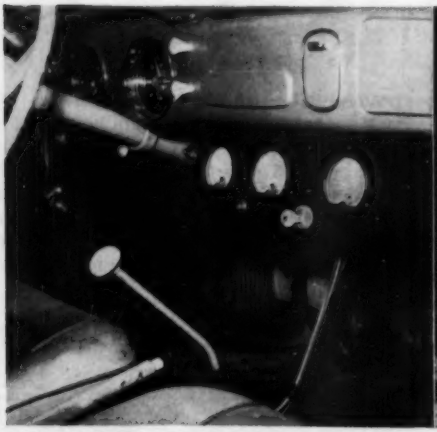
"WHAT ya got there, Mac?" asked the kid in the hot rod as a jaunty little foreign-looking car rolled soundlessly up beside him. "Hasn't it got an engine? I can't hear a thing."

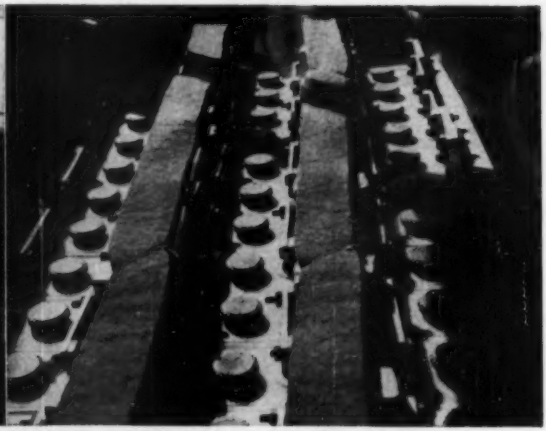
The other man laughed. "This car runs on electricity," he explained.

The light changed and the hot rodder hit the throttle. "Oh yeah?" he called back. "My car runs on atomic energy!"

The joke was on him, though. Deane L. Van Noy, a 42-year-old San Diego manufacturer, who was at the wheel of the silent automobile, really *was* driving an electric. The company he heads, Stinson Aircraft Tool & Engineering Co., is now building it.

The Charles Town-About is a brand-new, electric-powered passenger car, the





ELECTRIC METERS REPLACE GAUGES on the control panel. This is a test car; production models will be neater. Two ammeters give the same current reading when the car is running properly. A voltmeter, marked like a fuel gauge, tells how much juice is left in batteries. Each of the 24 two-volt cells has a spillproof cap and can be replaced individually. They weigh 528 lb.

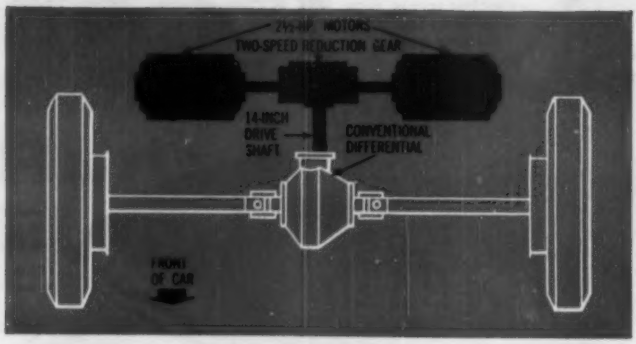
Baker Electric—1914 model at right—was the granddaddy of electric autos. Gas engine killed it by the end of WW I.

NICKNAMED "VOLTS WAGON" by one wag, the Charles Town-About resembles a VW Karmann-Ghia. Its 300-pound fiber-glass body is 13½ feet long, five feet wide and comes in black, blue, gray and bronze. Height is four feet nine inches. There are seats for four passengers, but two had better be small children. Electric motors and transmission are in rear, eliminating floor tunnel. The trunk, up forward, is all space.

first to go into production in nearly 40 years. It looks a lot like a Volkswagen Karmann-Ghia. An astonishingly lively little car, it is not in the least like the stately electric broughams that old ladies used to steer to matinees. This one is fun to drive. If the Eastern electric-utility companies that have ordered the first 100 off the production line are correct in their estimates, it will also be excitingly economical to run. They estimate that keeping the batteries charged will cost about 18 cents per 78 miles of travel.

Christened in honor of its financial godfather, Dr. Charles H. Graves, 40, a San Diego dentist, inventor, and real-estate man, the Charles Town-About is a promising infant. Within a month of the time

Electricity from the car's batteries runs its motors by



TWO DC MOTORS, geared to a single driveshaft, turn rear wheels through a standard differential. Rated at a mere 2½-hp. each, motors are three to four times more efficient than a gasoline engine and deliver 75 percent of their power to the wheels.

that word of its gestation leaked out, last fall, the Stinson company received nearly 10,000 letters of inquiry. Many of them contained substantial checks, offered as deposits on future purchases. The checks had to be returned, for Town-Abouts won't be available to the public until April, and at first only in San Diego.

WELDED ALUMINUM FRAME held by Dr. Graves weighs 57 pounds. Heat-treated, it can support twice the car's weight. The rectangular section in the middle cradles 528 pounds of batteries.

Range: 80 miles . . . speed: brisk. The Town-About, which will retail in its home neighborhood for $2,800, can go 75 or 80 miles before its batteries need recharging. This estimate of its normal driving range is based on the results of repeated runs over a 12½-mile course near the factory. The route crossed widely varied terrain, including six-percent grades.

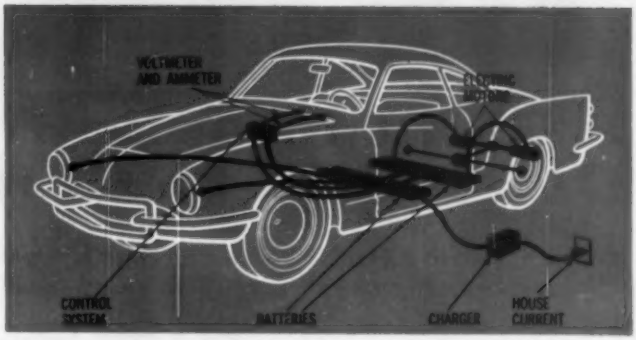
Perhaps the most remarkable fact about the Town-About is that with but two 2½-hp. DC motors pushing, it has slid swiftly and easily up to 58 m.p.h. That was achieved with the test car; the builders expect higher speed from their lighter production model.

The car's acceleration seems astonishing, too, to anyone who remembers the sedate pace of the lofty old electrics. The Town-About's 3,000-lb. test car has zipped from a standing start to 35 m.p.h. in nine seconds, to 42 m.p.h. in 12 seconds and to 52 m.p.h. in 20.

This sprightly performance is due partly to lusty rear-axle gearing—15.3:1 in low range and 3.6:1 in driving range. The builders suggest that the fact that the car is preponderantly tail-heavy helps, too. Sixty-five percent of its total weight is at the rear.

The problem: lightweight power. When Graves and Van Noy were first experimenting with the Town-About's power plant, seasoned electrical engineers told them it would be impossible to give a car of its planned weight (1,875 lb.) the speed and acceleration they wanted with less than 40 hp. Two electric motors producing that much power would have cost $2,200 each and weighed 600 lb.

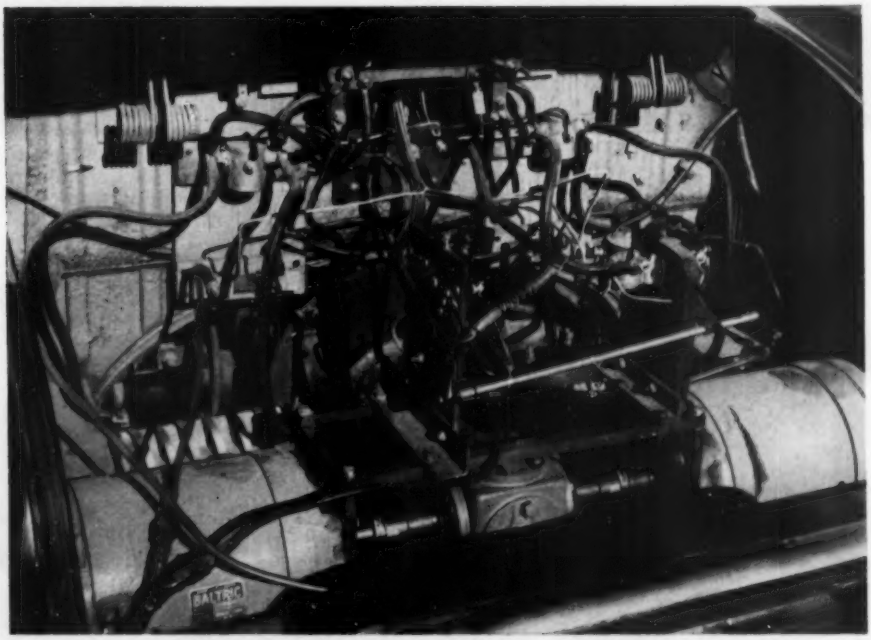
day; at night you plug a charger into the house current



STORAGE BATTERIES power everything—drive motors, lights and horn. If they go dead, a five-minute wait rejuvenates them enough to drive another six miles. Complete recharging takes seven hours. The charger provided can be kept in the car, or at home where it's plugged in.

Graves and Van Noy nearly gave up then. But with patient persistence, and frequent road trials of techniques and equipment on an electric golf cart, the Tee-Bird, which they manufacture, they came up with an answer. Its details are a highly prized trade secret. The power plant of the Town-About is located aft of the rear axle. The motors are mounted at opposite sides of the back compartment, with their spindles entering a common gear-reduction box centered between them. This gearbox is connected to the differential by a 14-inch driveshaft. Up front, beneath the accelerator, is a slim,

[*Continued on page 274*]



REAR ENGINE COMPARTMENT of the test car houses two electric motors whose shafts meet in a gearbox (bottom of picture). Mounted above it (center) is a rheostat for controlling speed. Production car will look neater, have a carbon-pile controller worked by accelerator.

PS EXCLUSIVE

AIR-LIFTING

a Giant Missile from California to Canaveral

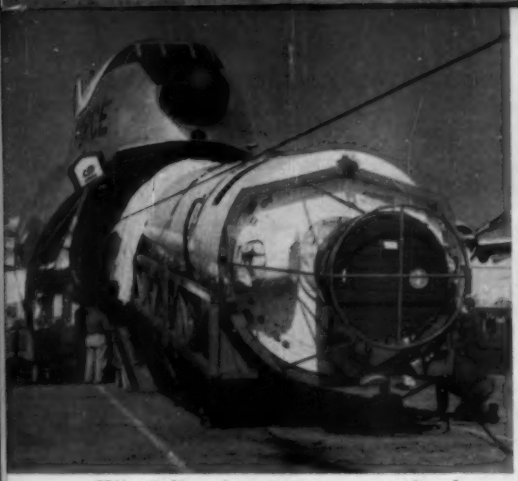
Jammed in with a Thor IRBM, a PS reporter shivers and sweats from "hairy" takeoff to touchdown 2,500 miles later

WHEN I saw the chalk-white monster with the blood-red whizpipe trundling slowly out of the Douglas factory at Santa Monica, California, I had a slight sinking feeling. This Thor IRBM not only looked too heavy for our C-124 Globemaster to carry—it looked as if they'd have to use a king-size shoehorn to get the beast aboard at all. Nor were we about to thunder out of some mammoth SAC field with miles of runway where a pilot might stop his plane casually and safely if one or more engines began to stutter. The Santa Monica strip

By Frank Harvey, with photos by W. W. Morris

The big cargo plane opens a yawning mouth to gulp down the 60-foot missile.

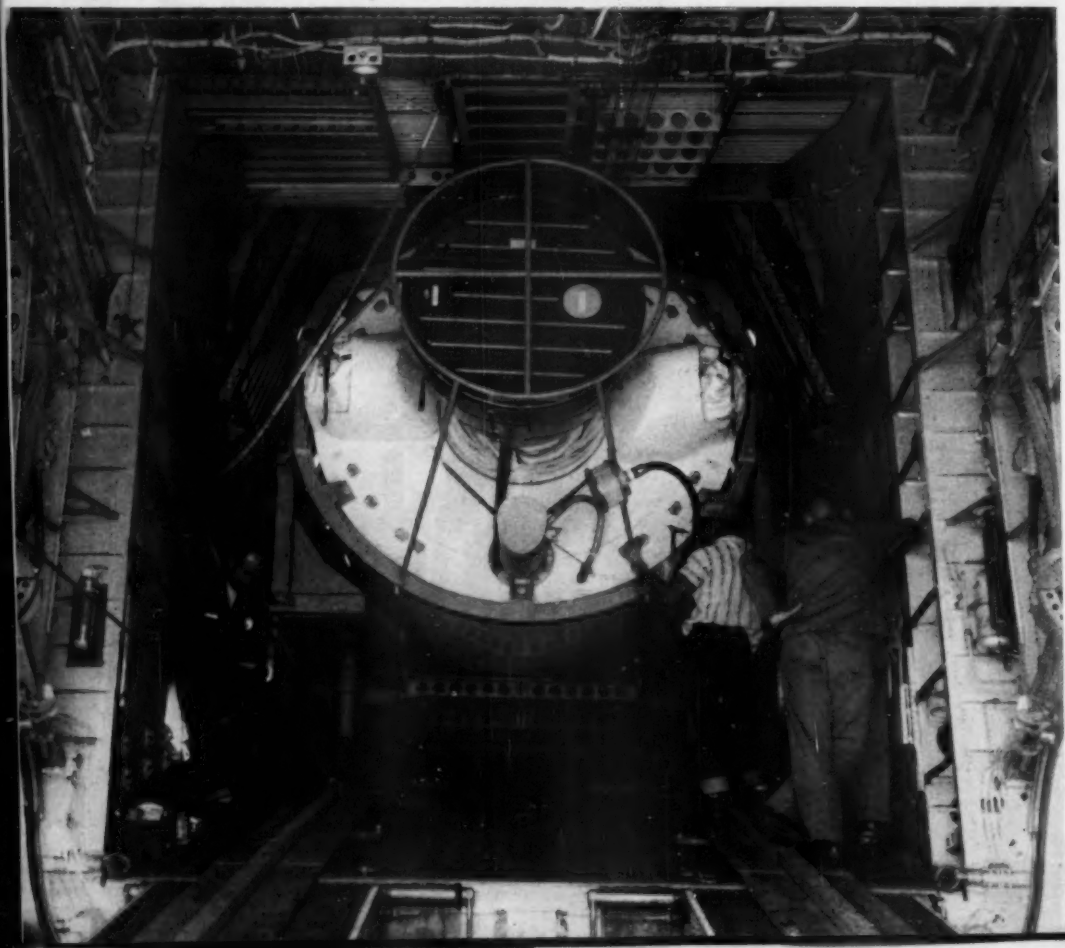
Canvas-shrouded against dust, moisture and oil leakage, a brand-new Thor IRBM approaches the shadowed belly of a C-124 Globemaster at Douglas factory field in Santa Monica, Cal.



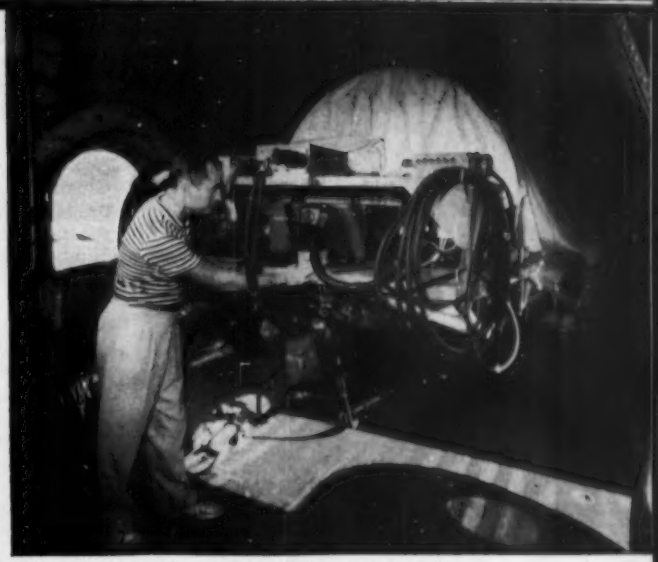
Winch-line draws taut across the sky as it cautiously inches the Thor into the gaping maw of its host.

Twin sets of wheels on the missile dolly fit neatly over central guide rails—insuring exact positioning.

The big gulp is finished and Douglas men chain the Thor missile vise-tight for the 2,500-mile flight from the West Coast to Cape Canaveral, Florida.



Fuselage packed solid with IRBM, it's easier to rope-lift personal gear into the 20-foot-high tail.



Thor nursemaid watches oil temperature in guidance system every minute. Failure of oil heaters could mean thousands of dollars' damage. Three power sources give triple insurance it won't happen.

is 5,000 feet long, not an inch more. And it was one of those hot afternoons when the air is thin and liftless . . . and the crash-landing area is houses, solid houses for miles.

"Like to ask a little question," I said to Major Harrison Blakey, USAF, Aircraft Commander of our C-124. "How many feet do you figure we'll have to run on the ground before we get off and start flying?"

Blakey is one of those deadpan chaps who's been everywhere and done everything you can possibly do in a big airplane (he flew bulldozers into crude snow strips at night when the DEW line was building). He jabbed a toothpick negligently into one corner of his mouth. "I figure we'll lift off at about 4,200 feet."

"But that's almost at the end of the runway!"

Blakey switched the toothpick to the other corner of his mouth. "Yep," he said, "and if the wind dies down and it gets hotter, we could roll a bit further still." He smiled faintly. "No sweat, friend. There's a great big gully at the end of the field. You can roll off the end of the runway and be flying—like an aircraft carrier, sort of. Get it?"

"I'm afraid I do," I said. "Thanks for the information."

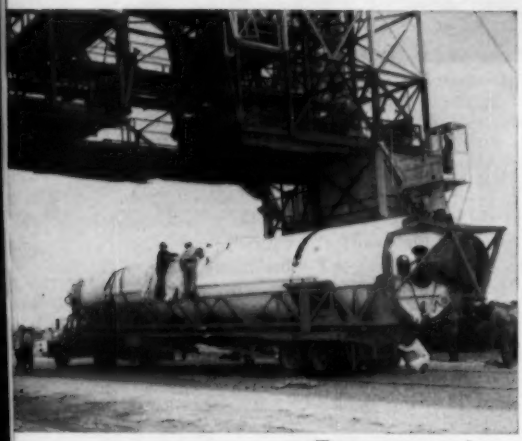
"Don't mention it," Blakey said. "Glad to set your mind at ease."

My mind wasn't exactly at ease, even though I knew the Air Force had been air-lifting these big 1,500-mile Thor IRBMs out of Douglas' Santa Monica plant for many months without a mishap. The bird that photographer Bill Morris and I would soon fly with was going to Cape Canaveral, Florida.

Loading the bird. The missile was now inching up the ramp into the gaping maw

To move through the Globemaster fuselage once the Thor is stowed, the crew must squeeze along wall—rough at 14,000 feet without walkaround oxygen bottle.

2,500 miles and 20 hours later, the Thor is offloaded by Douglas men at skid strip on Cape Canaveral.



Transport truck brings Thor from skid strip to gantry tower where it will be erected, checked, fueled, and fired.

Balanced on a column of fire, Thor shows her stern to earth on her way up into the starry blackness of outer space.

of the C-124, its dual dolly wheels gloved down over guidance rails to keep it straight, and Douglas folks with earphones were directing the slow, cautious winching of the big bird into place. To prevent the 60-foot-long missile from poking a hole in the plane's roof as it climbed the loading ramp, the forward dolly wheels were lowered by hydraulic pressure and the rear wheels (still outside on the ramp) were jacked up. Despite the extremely close quarters, the bird was stowed, chained tightly, and covered with a tarpaulin in less than 40 minutes. It filled the fuselage so completely that I had to turn sideways and wriggle past the body of the missile to get to the rear.

Nursemaid to the Thor. At the rear stood a serious, dark-haired young man who introduced himself as Jack Gachesa, lead man on a missile test stand at Cape Canaveral, who would watch over the Thor in flight. There was some sort of very special oil in the guidance system of the Thor. This oil had to be held at a precise temperature at all times or serious damage—maybe $100,000 worth—could result. To insure that juice wouldn't stop getting to the heating elements, and hence to the oil, the missile was equipped with three separate power sources: the plane's electrical system, a small hand-cranked gasoline generator, and nickel-cadmium batteries with three to four hours' worth of heat in them—which would take over automatically if the other sources failed.

"Why is heat so critical in this oil for the guidance system?" I asked Gachesa.

He looked at me (these magazine writers, what dopes!) and said, "The guidance system of any long-range missile is very sensitive. Some are so sensitive that all you need to do is put your bare hand on the outer skin and you get a measurable reaction in the guidance system."

Tricky takeoff. I shut up, and presently we heard the C-124's engines fire up with much stuttering and backfiring and clouds of smoke that eddied into the open rear cargo doors. Sergeant Arthur Russell, a red-faced, roly-poly fellow with the energy of a medium-size dynamo, wriggled back over the tie-down chains, shoved the doors in place and crouched down, peering through a window. He wore earphones and mike to monitor the takeoff. "Scan-

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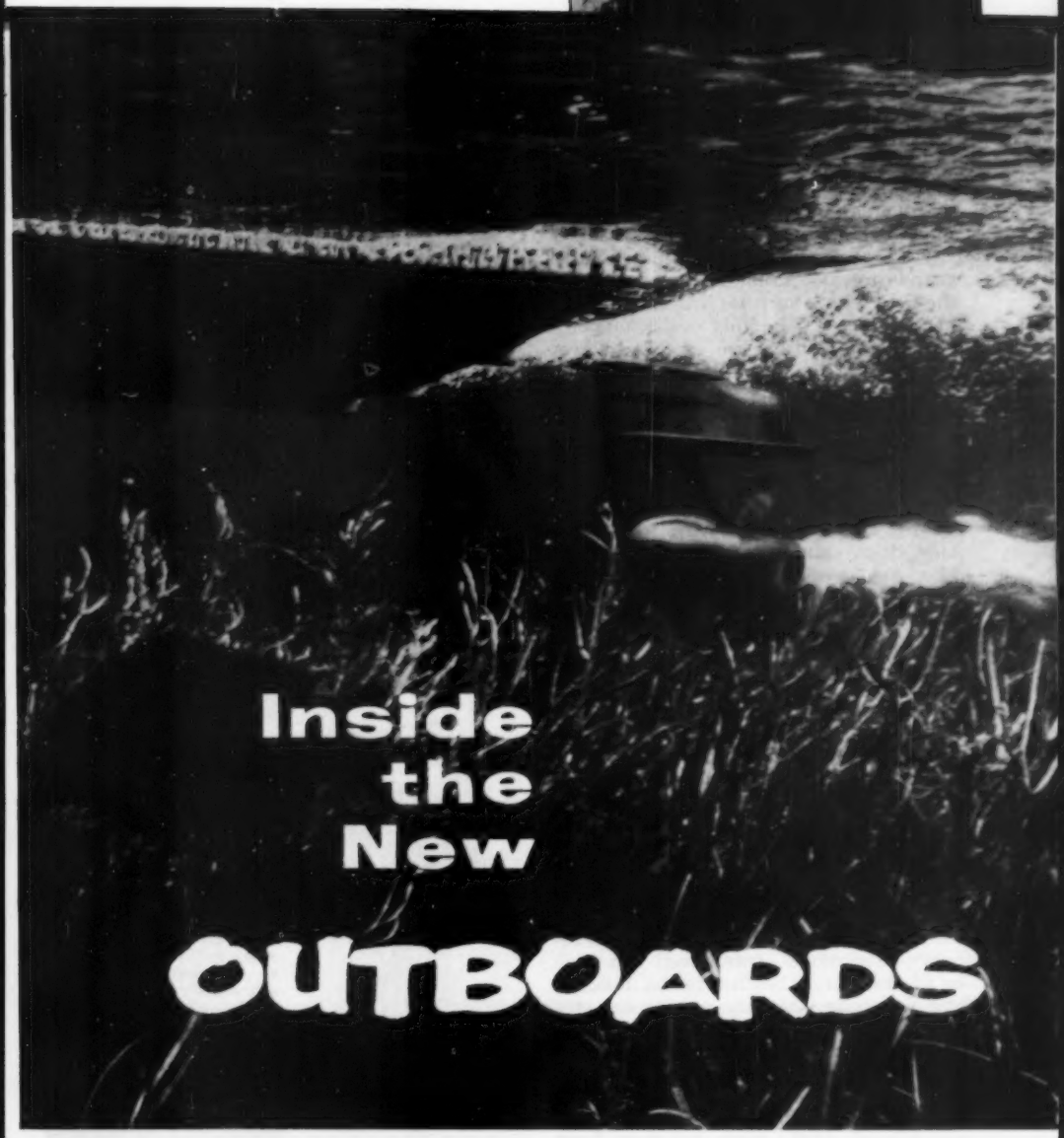


Inside the New OUTBOARDS

No big changes, but smart engineering has weeded out the bugs and come up with trouble-free, safer, more-for-a-buck motors

By E. F. Lindsley

BUY a new outboard in 1959 and you'll likely be a happy owner. If high styling is your dish, it's there . . . in colors. More important, this year shows the solid results of the long, frantic postwar scramble to be first with the mostest. Last year's dramatic changes, new cylinder arrangements and furious race up the horsepower ladder have given over to calm, contemplative, pipe-smoking engineering of the kind that weeds out bugs and gives the boatsman sound, trouble-

free, high-performance outboard engines.

The price line has held fairly stable. There are a few modest increases, and even some decreases (Scott has trimmed prices on all but one model), but the 1959 buyer will get an honest dollar's worth.

Horsepowers are high, but no higher than last year; and unless someone scoops the field with a surprise introduction of a brute-powered job (this could happen), most manufacturers are content to keep the big blasts behind laboratory doors for a year or two.

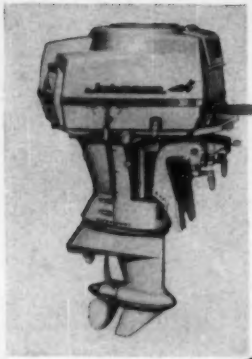
Outboard Marine (Johnson and Evinrude) is definitely aiming at the "boating family" market. Although there is plenty of speed in the big V-4 models, the primary object is an adequate power reserve for the bigger boat carrying a cargo of kids, dogs, camping equipment, and the like. Ask questions about a horsepower race here, and you'll be told that safety for emergencies, as well as long, reliable performance are first considerations.

Quiet operation and wave and weather protection come from the sealed fiberglass covers, and starter design has been modified so that even a slightly unhealthy battery will kick the engine over. It's little changes like this in starters, generators, carburetor controls, and other obscure but vital places that make 1959 a prime model year.

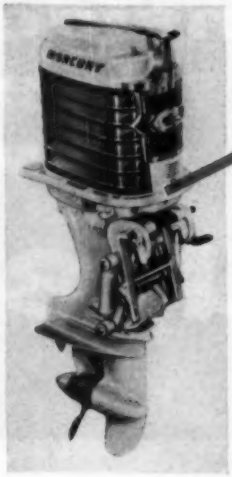
A highlight of Outboard Marine's modifications is the extension of the cooling-water thermostat all down the line with the exception of the diminutive three-horsepower model. Introduced last year on the two larger engines in the Johnson and Evinrude lines, these units are still novel in the outboard field. Two thermostat setups are used. On the 50- and 35-horsepower engines, part of the water is recirculated. The smaller models simply choke down the flow, depending on the temperature of the incoming water, and thus hold jacket-water temperatures in a cozy range.

Both Evinrude and Johnson conducted widespread tests with thermostats, and some of the advantages claimed are longer life, better idling, improved economy, and reduced port carboning. Obviously, the colder the water to start with, the greater the advantage gained from the stat. If your boating waters run to bathtub temperatures, you may not notice much difference. But if you operate in

BIGGEST EVINRUDE, the Starflite, weighs 221 lb., boasts a V-4 engine, sound-sealed power, thermostatically controlled cooling.



BIGGEST JOHNSON, the Super Sea-Horse 50, weighs 215 lb., also boasts a V-4 engine, controlled cooling, soundproofing.



BIGGEST MERCURY, the Mark 78A, 188 lb., developing 70 hp. with six cylinders, calls itself world's most powerful family outboard.

BIGGEST SCOTT, the Flying Scott, 186 lb., has a three-in-line design offering "big power in a small dependable package."

'59 Specs on the Leading Outboards

MAKE	MODEL	HORSEPOWER	NO. OF CYLINDERS	BORE AND STROKE (inches)	DISPLACEMENT (cubic inches)	REVERSE (pivot, gear, automatic or direct)	STARTING (manual or electric)	GENERATOR	FUEL TANK (integral or remote)	ENGINE WEIGHT (pounds)	PRICE
EVINRUDE	Lightwin	3	2	1 3/16 x 1 3/8	5.28	piv.	man.		int.	33	$160
	Fisherman	5.5	2	1 15/16 x 1 1/2	8.84	gear	man.		rem.	56	$230
	Sportwin	10	2	2 3/8 x 1 7/8	16.6	gear	man.		rem.	67	$310
	Fastwin	18	2	2 1/2 x 2 1/4	22	gear	man.	kit	rem.	79	$395
	Big Twin	35	2	3 1/16 x 2 3/4	40.5	gear	man.		rem.	125	$525
	Lark	35	2	3 1/16 x 2 3/4	40.5	gear	elec.	yes	rem.	138	$625
	Four-Fifty	50	V-4	3 x 2 1/2	70.7	gear	man.		rem.	209	$750
	Starflite	50	V-4	3 x 2 1/2	70.7	gear	elec.	yes	rem.	221	$850
JOHNSON	Sea-Horse 3	3	2	1 3/16 x 1 3/8	5.28	piv.	man.		int.	33.25	$160
	Sea-Horse 5 1/2	5.5	2	1 15/16 x 1 1/2	8.84	gear	man.		rem.	55.5	$230
	Sea-Horse 10	10	2	2 3/8 x 1 7/8	16.6	gear	man.		rem.	67	$310
	Sea-Horse 18	18	2	2 1/2 x 2 1/4	22	gear	man.	kit	rem.	77	$395
	Sea-Horse 35 Super	35	2	3 1/16 x 2 3/4	40.5	gear	man.		rem.	128	$525
	Sea-Horse 35	35	2	3 1/16 x 2 3/4	40.5	gear	elec.	yes	rem.	136	$625
	Sea-Horse 50 Super	50	V-4	3 x 2 1/2	70.7	gear	man.		rem.	207	$750
	Sea-Horse 50	50	V-4	3 x 2 1/2	70.7	gear	elec.	yes	rem.	215	$850
MERCURY	Mark 6A	6	2	1 3/4 x 1 1/2	7.2	piv.	man.		rem.	46	$225*
	Mark 10A	10	2	2 11/32 x 2 1/8	18.5	auto.	man.		rem.	77	$310*
	Mark 15A	15	2	2 11/32 x 2 1/8	18.5	auto.	man.		rem.	83	$345*
	Mark 28A	22	2	2 3/4 x 2 1/8	22	auto.	man.		rem.	88	$410*
	Mark 35A†	35	4	2 3/4 x 2 1/8	40	gear	man.	opt.	rem.	123	$480
	Mark 55A†	40	4	2 3/4 x 2 1/8	44	gear	man.	opt.	rem.	125	$540
	Mark 58A†	45	4	2 3/4 x 2 1/8	44	gear	man.	opt.	rem.	127	$600
	Mark 75AE	60	6	2 3/4 x 2 1/8	66	direct	elec.	yes	rem.	185	$865
	Mark 78AE	70	6	2 3/4 x 2 1/8	66	direct	elec.	yes	rem.	188	$925
SCOTT	Scott 3.6	3.6	1	2 1/8 x 1 3/4	6.23	none	man.		int.	36	$132.50
	Scott 5	5	2	1 11/16 x 1 43/64	7.48	gear	man.		rem.	49	$239.95
	Scott 7.5	7.5	2	2 x 1 3/4	11	gear	man.		rem.	61	$279.95
	Scott 10	10	2	2 11/64 x 2	14.82	gear	man.		rem.	65	$319.95
	Scott 25	25	2	2 51/64 x 2 3/16	30	gear	elec.	yes	rem.	120	$449.95
	Scott 40	40	2	3 1/8 x 2 3/4	42.18	gear	man.		rem.	131	$529.95
	Scott 40 Royal	40	2	3 1/8 x 2 3/4	42.18	gear	elec.	yes	rem.	145	$629
	Scott 40	40	2	3 1/8 x 2 3/4	42.18	gear	elec.	yes	rem.	145	$699
	Flying Scott	60	3	3 1/8 x 2 3/4	63.27	gear	elec.	yes	rem.	186	$950

†Available in optional combinations: electric starter, starter and generator, long shaft; weights given are for standard length models, less fuel tank.

**Includes propeller; prices on others in Mercury group are without propeller.*

chill waters at least part of the time, as a large number of commercial fishermen and workboat operators do, you may be pleasantly surprised.

For the technically minded: Outlet temperatures are held to about 150 degrees and the differential across the block is held to about 25-30 degrees.

Also new, although not noticeable to the eye, is a propeller change on the 50-horsepower V-4s. In addition to a change in metal alloy making for greater resistance to damage and easier repair, the former 13-by-13 prop is now 12 1/8 by 14, said to give better all-around performance with most boats.

Kiekhaefer Corporation, maker of the always-hot Mercury line, continues to lead in power output with their 70-hp. 78A. In addition they now offer a new 15-horsepower "fishing-class" job and a 35 for general use. Nearly any option of power, electrical equipment, and accessories can be worked out in the Mercury line.

All engines of 35 horsepower or more in the Mercury line can have electric starting and a generator; five offer single-lever control, and three can be equipped with hydraulic-shock struts to soak up impacts from underwater obstructions. This last feature is coupled with a shut-off

switch to cut the ignition temporarily until a normal engine attitude is regained.

Like other builders, Mercury is very conscious of fuel consumption. They've equipped five models with an economizer feature reported to give as high as 60 percent better fuel mileage at moderate cruising speeds.

Without delving too deeply into the two-cycle digestive system, it can be said that these economies result from carefully calculated spark-advance boosts under part-throttle conditions. The principle is used on other outboards although Mercury claims their small-bore designs are inherently adapted to such measures because of shorter flame-front travel and more easily managed combustion patterns.

Automatic transmission, so called, is an especially interesting Mercury feature on the 10-, 15- and 22-horsepower models. Although this does not refer to a succession of gear-ratio changes as in a car, it does give a smooth transition between forward and reverse with a single-lever control. Of constant-mesh design, this transmission accomplishes shifting by the gripping or releasing action of wire-coil clutches acting much like the bands in an automotive transmission. The components of this remarkable mechanism are above the water line and halfway down the drive shaft. This eliminates reverse gears in the lower unit, cutting bulk and drag.

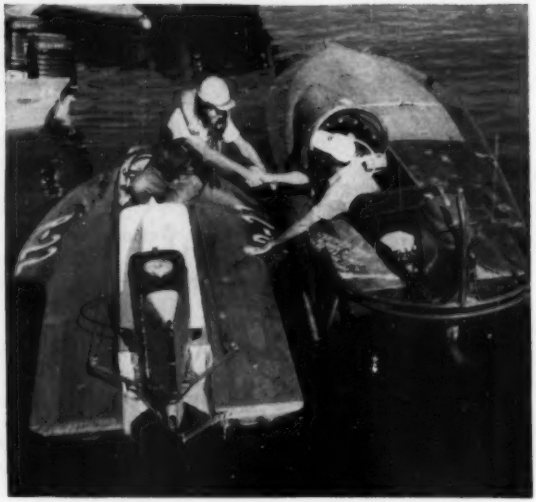
Mercury retains its direct-reversing system in the 78A and 75A; the engine actually stops and quickly restarts in reverse. For those who wonder about the water pump when this happens, it reverses with the rest of the engine, but check valves switch the cooling-water flow at the same time.

The 1959 Scotts (formerly Scott-Atwater) are produced by the Marine Products Division of the McCulloch Corporation, a firm noted for progressive engineering. Scott is proud of the compact three-cylinder, 60-horsepower model which was introduced last year and is again available with a number of deep-down refinements. This engine uses a 12-volt battery-ignition system but differs from automotive practices by boasting three separate sets of points, condensers and coils, one set for each cylinder. This is said to offer great reliability, and Scott points out that the engine can be started with a very low cranking speed.

Other engineering jobs that don't show through the sleek and colorful fiber-glass covers are cleverly worked out ramps on the shift clutch dogs which eliminate delay and improve shifting, double-lip lower water seals to ease the fishline menace, and tilted reed boxes to reduce fuel-puddling problems. This latter phenomenon is common to two-cycle engines and re-

[*Continued on page 278*]

Outboards set speed and endurance records



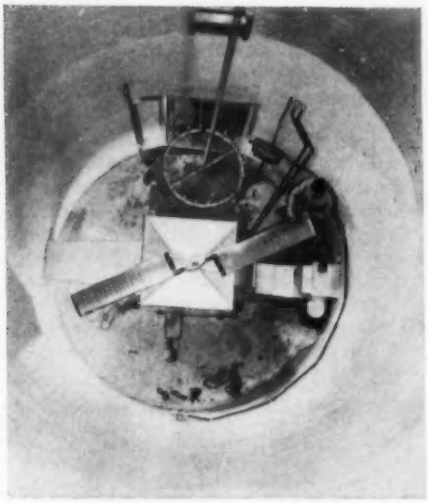
These craft made record-breaking speed and endurance runs last year. At left is the hydro, powered by a 60-hp. Mercury competition engine, with which Hugh Entrop brought the world speed record back to the U. S. after 21 years by running at 107.9 m.p.h. Right, a 17-foot family runabout powered by a 60-hp. Mercury, after traveling 50,000 miles in 68 days. Shaking hands are Jack Leek, mechanic for the speed run, and Jim Wynne, of the distance-endurance team.

Big squeeze put on steel pipe

THIS machine bends 12-inch steel pipe on location to match hill contours and ditch curves. It is being used by Pacific Gas and Electric in laying a 163-mile gas line in California's Sacramento Valley.

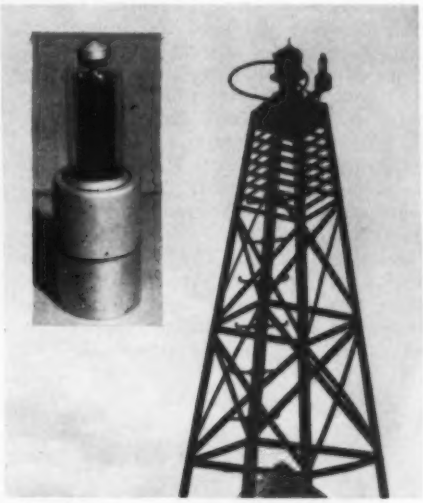
Ship takes on whirlybirds

USS JUPITER, the Navy's only aviation supply ship, now has a flight deck for helicopters—a platform over its fantail. It speeds delivery of aircraft parts to Seventh Fleet carriers based in Japan.



Radome samples get rain test

SPINNING in the rain on rotor blades, rubber for de-icers and radomes is tested for erosion by B. F. Goodrich at the bottom of this tower. Rain comes from a ring of jet nozzles suspended from the top.



Sun operates lighthouse lamp

SUNLIGHT striking a silver control for this new Coast Guard lamp (shown close up and on a lighthouse) expands the switch, opens the circuit, puts the light out. It goes on at night and on dark days.

Can We Catch Up with Russia on A-PLANES?

By Alden P. Armagnac

BARELY more than a year after the Russians sent up the first Sputnik came reports that they were secretly test-flying the first atomic-powered airplane. By the time you read this, Moscow may have officially proclaimed the news.

If so, or if confirmation comes soon, another stunning technological victory over the United States will have been handed to the Reds virtually by default.

When the A-plane race began, soon after the end of World War II, the U. S. had every opportunity of winning. Today, after spending 13 years and upward of $700,000,000 on it, we still have no A-plane. And we may wait three or four more years for one—unless a drastic speed-up should result from the imminence or fact of Russian success.

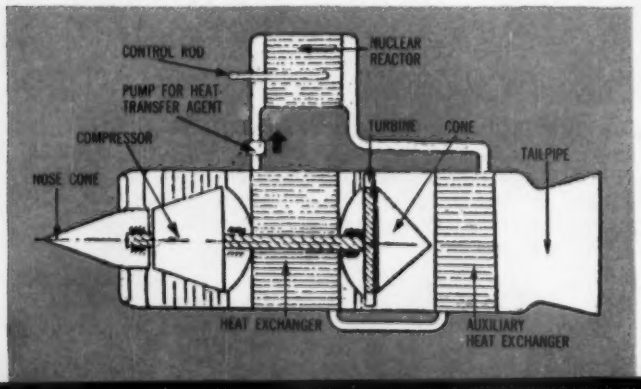
Although the White House and the Pentagon were skeptical of the unofficial reports that an A-powered Red bomber was flying already, there was little doubt of its happening soon. The man who heads our Aircraft Nuclear Propulsion Program —Maj. Gen. Donald J. Keirn, of the U. S. Air Force—had conceded the Russians a good chance of getting an atomic airplane into the sky first, possibly early this year if not before.

The Reds' first A-plane might not be too sophisticated a flying machine, Gen. Keirn suggested—as if in consolation.

Prophecy and product. In contrast were advanced Soviet designs in a handbook titled *Applications of Atomic Engines in Aviation,* published in Moscow in 1957 by the Ministry of Defense of the USSR and highly enough regarded in this country to have been translated into an English edition at Wright-Patterson Air Force Base.

And the Russian A-plane reported actually to be making test flights was no makeshift, but an impressive military prototype, according to its description in a leading U. S. aviation trade journal.

The magazine, *Aviation Week,* described the plane seen by Western observers over Moscow and on the ground as a delta-winged bomber of about 195-foot length, 78-foot wingspan, and 300,000-pound gross weight. It was said to be powered initially by two atomic turbojet engines, already "definitely tested in the air"; and two conventional ones, later to be replaced by A-engines. Its reported speed was in "high subsonic and low su-



A-ENGINE DESIGNS in Russian handbook, translated at U. S. air base, show advanced Red concepts. Example is this A-engine with an "atomic afterburner," or auxiliary A-heater for air, in tailpipe. In contrast, U. S. plan combines A-engine with afterburner using ordinary fuel.

"RUSSIAN A-PLANE" pictured by *Aviation Week* from unofficial reports has two jet A-engines in nacelles below wings, conventional jets at wingtips.

personic range"; its "thin, high-speed airfoil" implied a higher future goal.

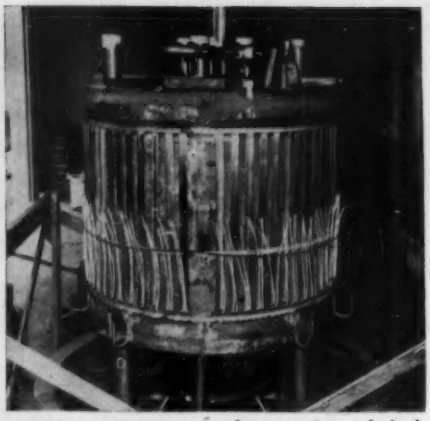
But what makes the A-plane a revolutionary military weapon is one simple and staggering fact: its unlimited range. Without need of refueling, it can circle the globe again and again. It can fly as far, or for as long, as sandwiches and coffee hold out for the crew.

The danger. A Russian A-plane "first" would betoken an ominous lead toward rolling out A-planes in quantity. A Red A-plane fleet, of which we had no counterpart, could place this country in mortal danger.

Imagine, says Gen. Keirn, an enemy A-fleet constantly circling in the sky off our shores—just beyond reach of our warning radar net. With long-range missiles launched from the air, this aerial armada at any moment could loose a surprise nuclear blitz upon our military, industrial

U.S. program has produced this hardware—but no A-plane

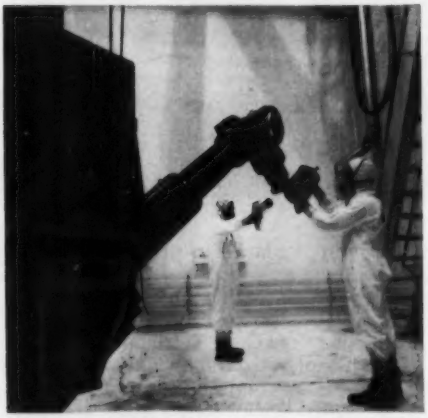
HOISTED IN AIR, shielded reactor aids studies of protection from A-plane's radioactivity, at 300-foot-high "Tower Shielding Facility" completed at Oak Ridge, Tenn., in April, 1954.



RUNNING RED-HOT on molten uranium-salt fuel, this three-foot-high atomic reactor yielded a modest 2,500 kilowatts in "Aircraft Reactor Experiment" at Oak Ridge in November, 1954.

and population centers. Then, swooping in low over paralyzed defenses, it could liquidate surviving targets at pointblank range.

A-planes of our own offer the answer. Currently our Strategic Air Command's "ground alert" concept calls for 15 minutes' warning time to get bombers aloft from its missile-vulnerable bases. But with A-planes an "airborne alert" system keeping SAC bombers always in the air would be feasible. That would deter surprise attack, declares Gen. Keirn, by insuring the survival of an effective retaliatory force.

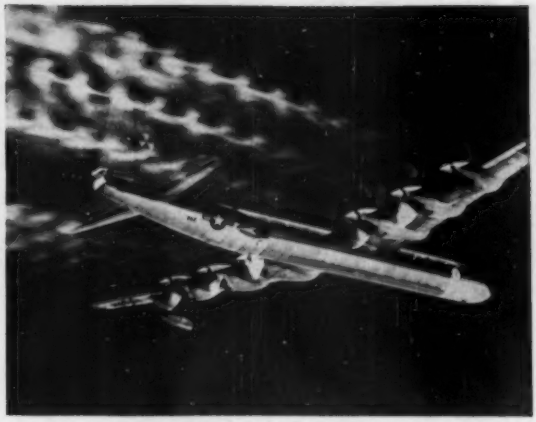


WORLD'S BIGGEST MECHANICAL ARM, "handing" object to worker here, operates by remote control to disassemble radioactive engine in GE's "hot shop" at Idaho A-plane test site.

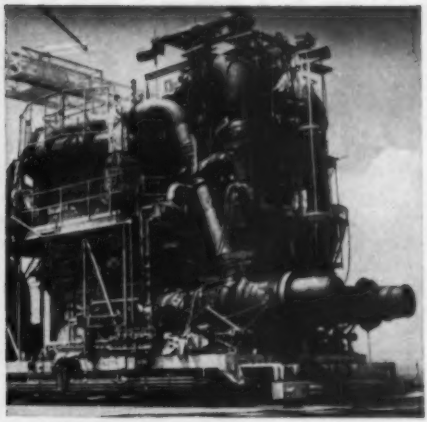
Designed especially for that mission, the A-plane now sought by the U.S. Air Force may be visualized as a fast missile-armed turbojet craft, capable of prolonged flight with a heavy payload, perhaps similar to a B-52 in size and weight. By latest report the Air Force now surprisingly favors a hybrid A-engine—a nuclear-powered turbojet, combined with an afterburner using ordinary fuel for extra thrust when needed. At this writing the Air Research and Development Command reportedly was studying A-plane designs by Convair and Lockheed, before deciding whether to award a contract to build a prototype.

While the Air Force's A-plane program is called the basic one because of the AF's "high-priority strategic mission," the Navy also has an A-plane project. Interested in a nuclear turboprop seaplane, the Navy would be happy with the slower propeller-driven craft, which it would use to transport heavy cargoes to remote outposts. Engineering studies by the Martin company are under way—but the Navy's A-plane, like the Air Force's, exists so far only on paper.

"Clean" and "dirty." For, before the A-planes, must come their A-engines. Two possible kinds, both under U. S. development, apply the same basic idea: A ura-



AIRBORNE REACTOR took 47 rides in this modified B-36, beginning in 1955, but didn't power the plane. Of only 1,000 kilowatts, the reactor made flight tests of shielding for A-planes.



JET ENGINES ran on atomic heat from high-powered reactor—grotesquely huge for a plane —in 1956-1957 Idaho trials. That was principal accomplishment of program revealed to date.

nium-fueled reactor, or atomic furnace, replaces a flame to heat the air stream rushing through a turbojet or turboprop engine, and so to yield a propulsive force.

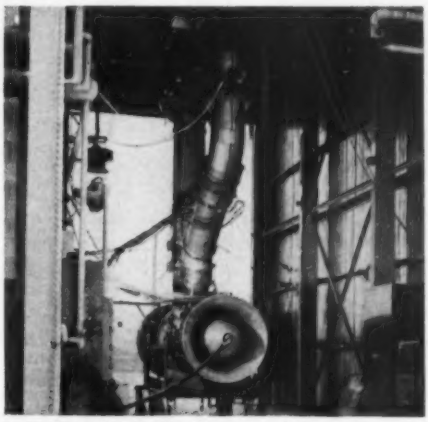
In the simpler kind of engine, the air stream flows right through the hot reactor. Since the air spewed out the tailpipe is radioactive, this is the "dirty" A-plane. (A more polite name: direct-cycle.) Because the radioactivity is extremely short-lived, the exhaust will not contaminate the atmosphere. Nor will its radioactivity harm a bystander far enough away not to be burned by its heat. But dust from the launching runway, sucked through the engine, could acquire lingering radioactivity, and cause serious contamination by settling back on the runway—which may therefore need to be water-sprinkled or otherwise freed of dust before a takeoff.

The alternate scheme conveys a reactor's heat, with molten metal for instance, to a heat exchanger in the engine; and this device heats the air stream. This is the "clean" A-plane. (Another name: indirect-cycle.)

The "dirty" A-plane engine appears to be the one further along in the U. S.—as perhaps also in Russia, whose reported "A-plane" was said to be a "dirty" one. At the Idaho test site of our A-plane program, General Electric has been trying out engines of this kind, developed at its Evendale, Ohio, plant. A "clean" A-engine, of which little has yet been heard, is under development by Pratt and Whitney at a newly built Middletown, Conn., nuclear-engine laboratory.

Ground tests. So far as has been publicly revealed, the principal result of our whole A-plane program to date has been successful operation, on the ground, of two turbojet engines under atomic power. This was accomplished at the Idaho site by General Electric in 1956-1957 trials.

[*Continued on page 270*]



TO READY jet engine for operation on A-power, check-up with regular fuel comes first. Ductwork above engine will divert its air stream through a reactor for atomic heating.

5 BUDGET SAVERS for Home Owners

1 An outdated TV table with a swivel top can take on new chores around the house. Used as a plant stand, it not only simplifies the handling and watering of plants, but can be turned daily to give them an equal opportunity for sunlight.

2 Protect your tools from rust by coating them with a thin film of oil after every use. A piece of felt cut from an old hat and stapled or tacked to a wood block makes a handy applicator. Oil the felt almost to saturation and store the tool preserver in an empty coffee can.

3 Get more wear from slip covers by mending rips and reinforcing worn spots on the underside with press-on patches. Use sheet-mending patches on thin, light-colored fabric; denim patches on heavy, dark-colored fabric.

4 Mixing paints to get just the color your wife wants to match the drapes needn't be wasteful. Do your experimenting with small amounts in paper cups, using measuring spoons. Keep checking the new color and when you hit on the shade that gets her okay, just mix the larger quantities in the same proportion.

5 Small hardware storage is neat and easy if you save flip-top cigarette boxes. You can pack a good many into a cigar box and they're easy to use, too. Slap masking tape across the top to cover the printing, then mark on it the item stored in the box, and its size. Since the lid stays with the box, there's never a chance of a mixup.

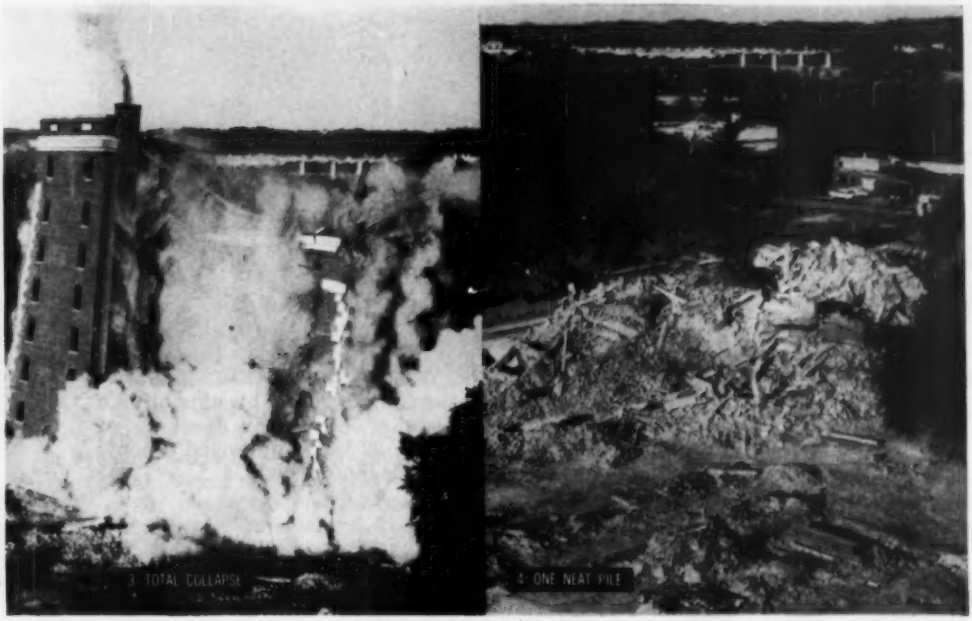
Picture News
IN THE WORLD OF SCIENCE

Hotter than fire. This new torch harnesses temperatures up to 30,000 degrees —highest in industry. It uses an electric arc concentrated by a plasma jet of ionized gas. Here a Linde Co. technician uses it to apply a heat-resisting tungsten coating on a missile nose cone spinning in a lathe. Solid pieces, such as crucibles, rocket nozzles, nuclear and X-ray parts, are built up on a mandrel that is later dissolved. Because of the powerful arc's high-pitched scream, the operator has to wear ear muffs.

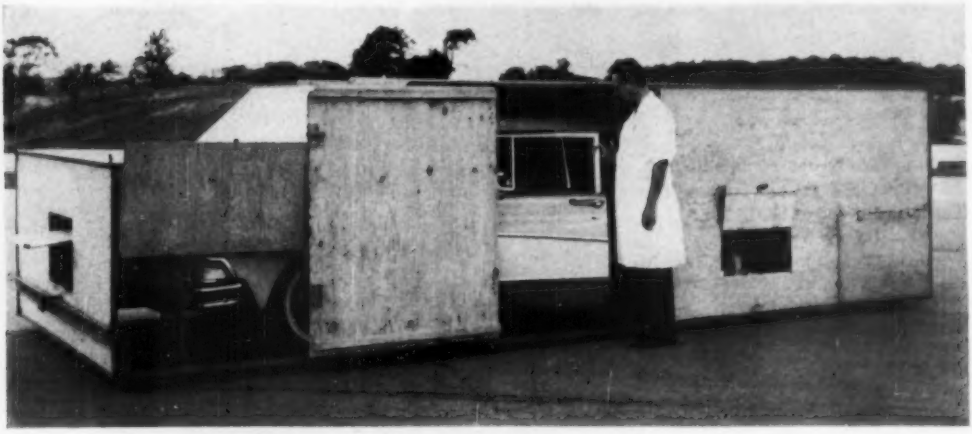
Artist at work. When Federal authorities decided to remove the eight-story apartment building above to clear a site in downtown Washington for the new State Department Building, they called on Jack Loizeaux, professional dynamiter of Towson, Md. He laced the structure with 200 pounds of dynamite, set in half-pound charges to go off at split-second intervals,

Nylon fingerprint. The Army now takes fingerprints with sprayed-on liquid nylon. Hardened in seconds, the stripped-off cast is a permanent plastic impression, easily handled, won't smudge.

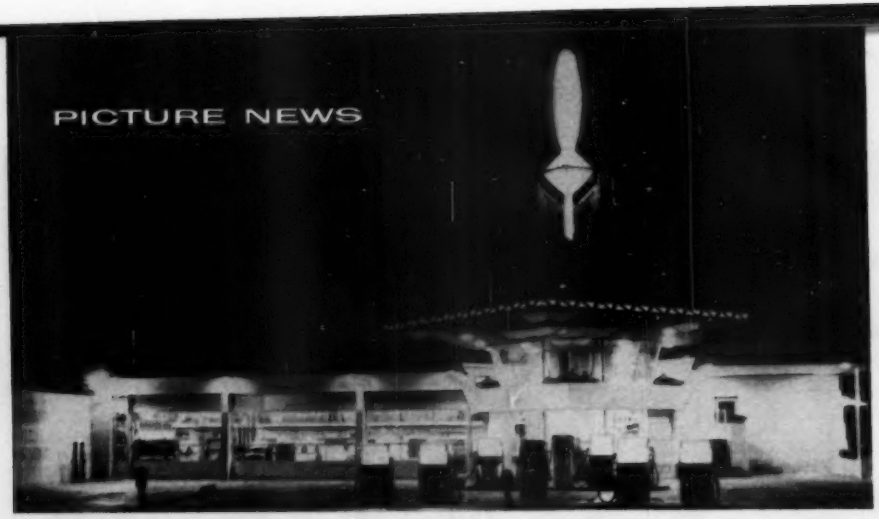
High fire fighter. This towering aerial, originally designed for trimming trees, is being tested in Chicago to combat stubborn blazes. It pours water from above, is sent to all extra-alarm fires.



and blasted away. The building was down in 15 seconds flat, as recorded here in sequence by the camera of Albert Peter Jr., and all rubble was in one neat pile ready for trucks to cart it away. This and two other similar buildings were cleared away by Loizeaux's method 45 days ahead of the conventional iron-ball-and-cable schedule—and at $55,000 less cost.



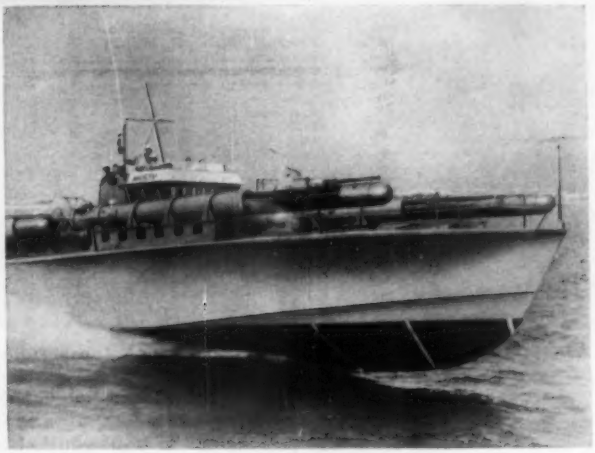
Boxed to go. Not intended for shipping, this squared case gives controlled air resistance so Ford engineers can measure the rolling friction of new cars without added complications. When a test car is towed by a second vehicle, a drawbar mounted between it and the box gives engineers readings in actual pounds of the pull required to overcome rolling friction.



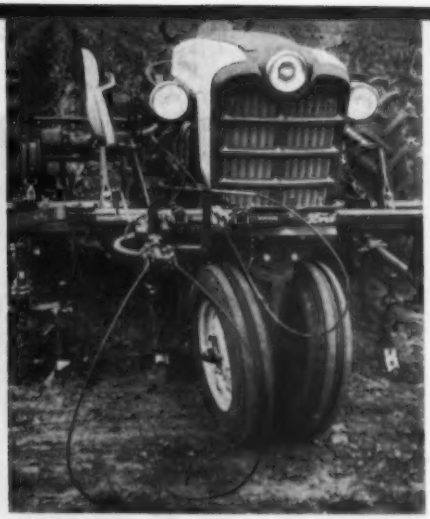
Rocket station. This illuminated sign resembling a rocket blasting off into space adorns a Minneapolis service station designed by Frank Lloyd Wright. The futuristic building features a 32-foot cantilevered canopy, copper roof and radiant heat. The tower is 60 feet high.

Portable pillbox. A medium tank (left) acquired from the Army serves as a self-propelled blockhouse that gives Rocketdyne technicians close-up observations of Atlas and Thor engine test firings at Edwards Air Force Base in California. From points of vantage the tank can withstand thrust blasts of upwards of 150,000 pounds.

Swiftest patrol. Capable of more than 40 knots, the 80-foot Norwegian craft at right is called the world's fastest patrol boat. It is powered by two Napier Deltic high-speed diesels, each rated at 3,100 hp. It carries four 21-inch torpedo tubes, two 40-mm. Bofors guns. The name "Nasty" on its superstructure is a warning to foes that the craft is ready to take on all comers.

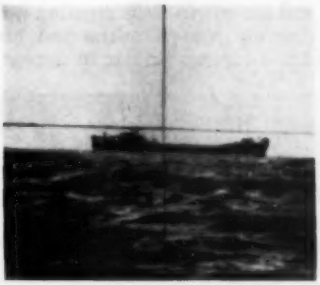


Germ-killing phone. The mouthpiece of this telephone rests in a receptacle containing a Westinghouse lamp that emits ultraviolet rays to destroy germs, bacteria and viruses. Replacing the receiver puts the lamp to work.

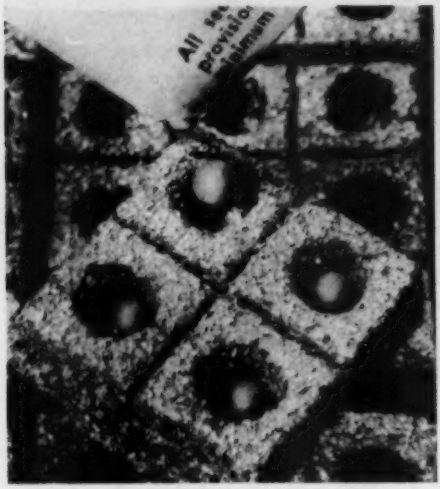


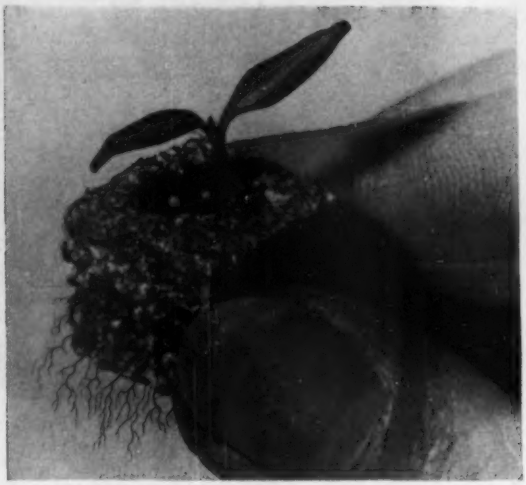
Robot cultivator. A feeler (foreground, above) on a new Ford cultivator tracks corn, cotton and other row plants. A servo-motor mounted in the steering linkage guides the machine by responding to feeler movement in either direction.

Atomic blowup. This sinking of an obsolete LST (right) was photographed through the periscope of the atomic submarine Sargo. It took place during training off Hawaii—is said to be history's first torpedoing by a nuclear submarine.



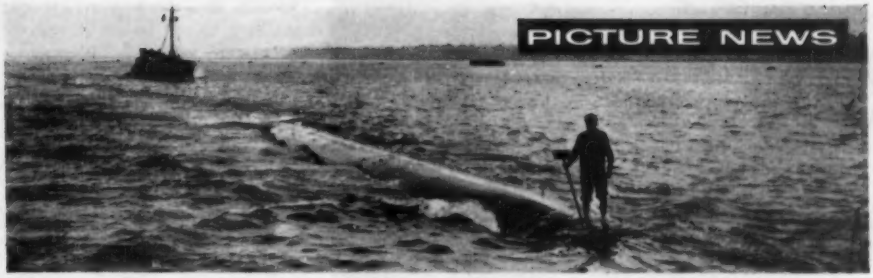
Mountain mover. Bucket by bucket, this big double-barreled LeTourneau machine scrapes up and carries earth—130 tons of it. A push on one button on the operator's panel lowers and digs with the forward bucket; another button repeats with the one in rear. Earth is dumped in layers from one bucket at a time or both together. Motors in each wheel propel the monster, drawing juice from a diesel-driven generator under the hood.



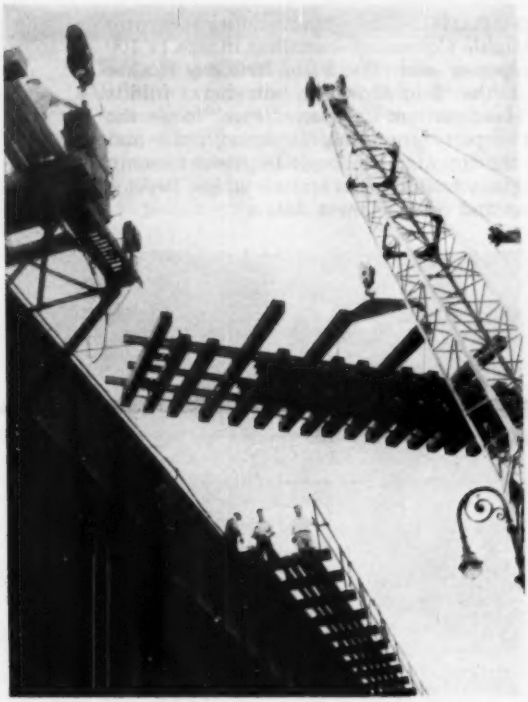


Magic planter. All you need to grow a plant is contained in these half-inch seed cubes, a British novelty. They are pressed from manure, vermiculite, bone meal, dried blood and other crop foods. A seed or two put into each and set out in final growing position in the garden does away with thinning out, transplanting and further nutriment. The seedling shown here is a lupine, similar in appearance to our Texas bluebonnet.

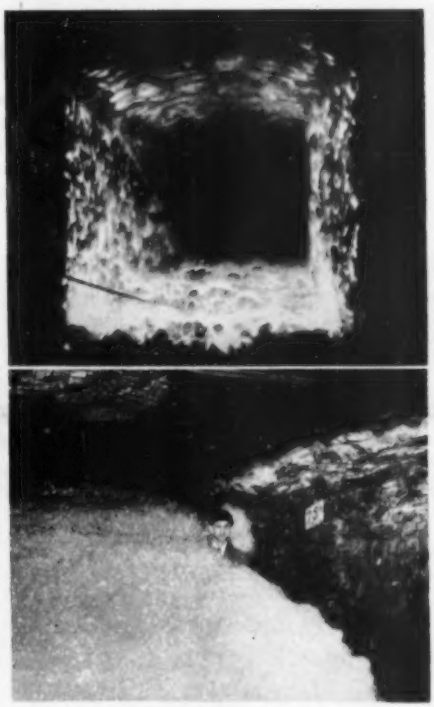
Rough rider. Bumps, corrugations and ruts are simulated at any desired speed on this test rig used by the Dutch makers of the DAF cars. Drums with attachable surface irregularities drive the front wheels while the rear are anchored to a raised platform. The rollers are mounted on a truck axle driven by an electric motor through a five-speed gearbox. And with the car raised, it's easier to study the effect of the rough ride.



Ocean-going sausage. This flexible oil barge of rubber-coated nylon carries 40 tons of cargo at half the costs of a conventional barge. It curves to follow the towing launch, turns in less than its length, causes no damage in collision, rolls up when empty like a toothpaste tube for return shipment. This one is 100 feet long. Its British developers plan units up to 300 feet with capacity of 1,100 tons.



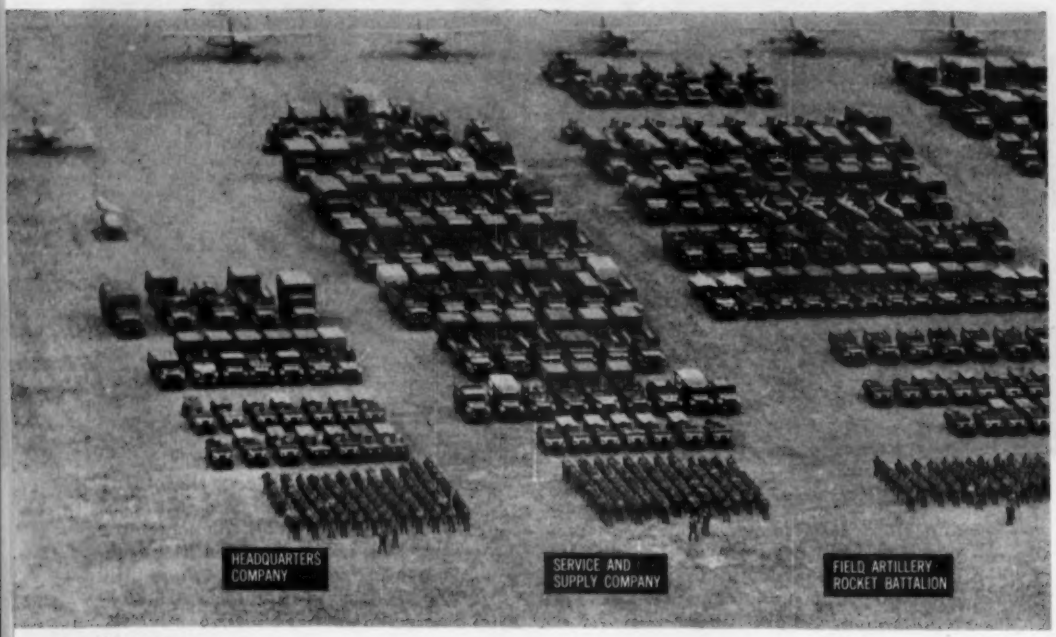
Prefab track. Here a 33-foot section —complete with ties, plates, footwalk and third rail—is swung into place by crane on one of New York City's elevated railroad lines. Prebuilding in the yards cuts work time and costs in repair and replacement of worn rails.

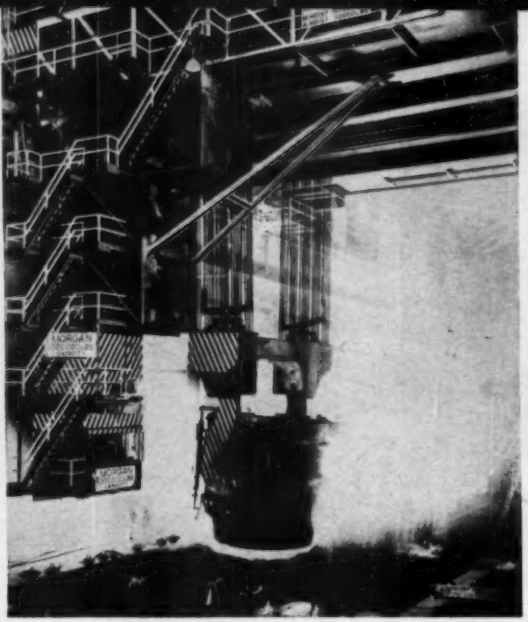


Fiery coal mine. To test the ability of foam to control mine fires, the U.S. Bureau of Mines set and quenched the fire above in a coal pit near Pittsburgh. Bubble-making solutions containing the same chemicals used in home and industrial detergents proved effective.

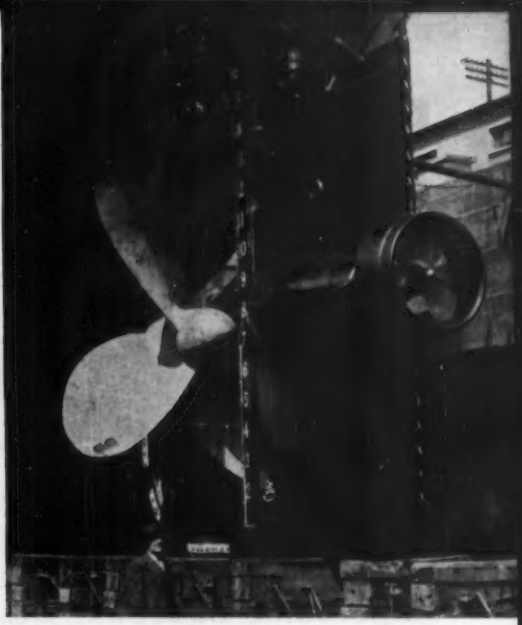
Gas saver. If you're willing to settle for a top of 45 m.p.h. you can squeeze 75 miles out of each gallon in this scooter's tiny gas tank. Lambretta's newest, the Surrey, has a body designed by Ghia on a standard utility chassis. Two passengers can ride in the wicker rear seat; another fits beside the driver in the cab. Removable canvas top and side curtains make it a convertible. The Italian import is designed especially for resorts, golf clubs, estates and the like.

What's behind the atomic punch. This dramatic photograph shows the Army's new Third Missile Command—smallest in size (1,100 men) but with the greatest firepower ever. The Field Artillery Rocket Battalion armed with Honest Johns (four shown on launchers) fulfills its basic mission aided by the Headquarters Company "eyes" to see the enemy target, by the Signal Company providing telephone, radio and other communications, and by the Infantry Company to prevent enemy infiltration. The Engineer Company builds roads and air strips; Service and Supply brings up food, gas and more Honest Johns.

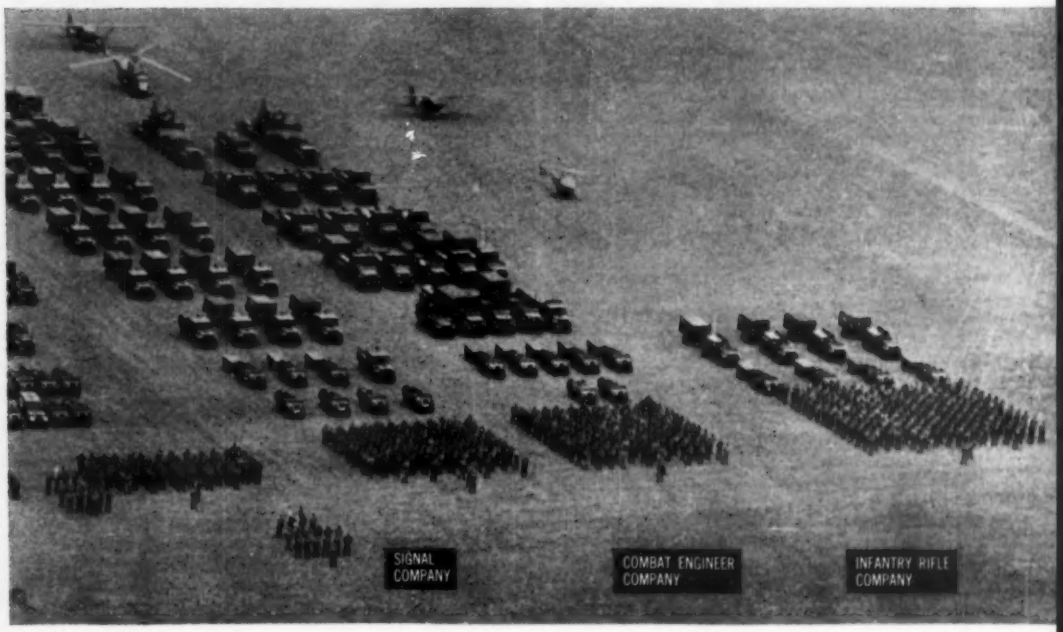


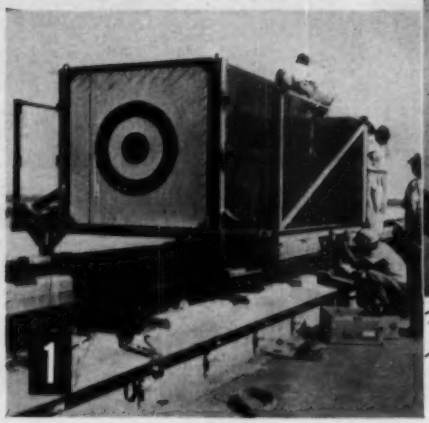


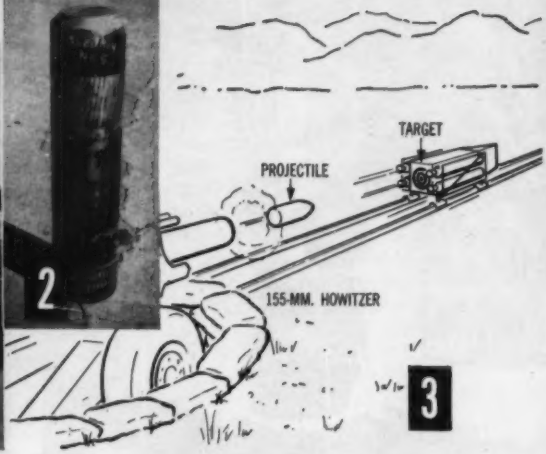
Big bucket. The world's largest ladle cranes—three 500-ton monsters spread over 6,000 square feet—haul 375 tons of molten metal each from steel-mill furnaces. Each is driven by 11 GE motors of 33 to 360 hp. operated from seven control panels with ratings up to 2,500 amps.



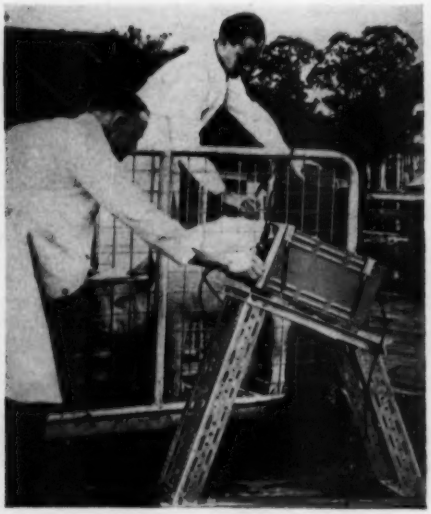
Power rudder. The bomb-shaped attachment above provides power steering for heavy freighters. The British-built unit is set in the normal rudder. Driven by a 150-hp. electric motor, it maneuvers the ship in shallow water and dock entrances, often without benefit of tugs.





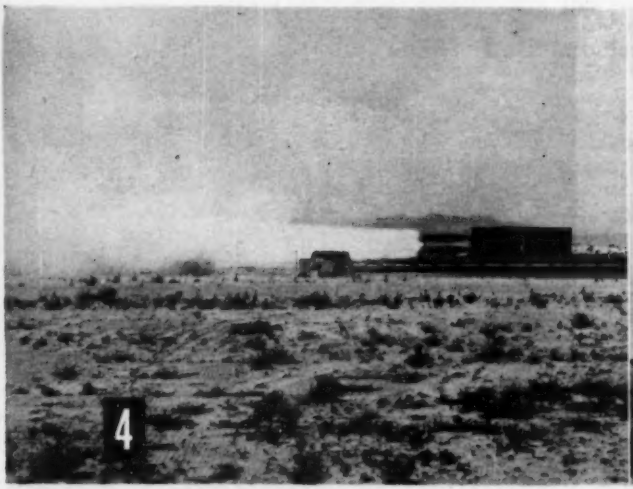


Supersonic baseball. In this game the catcher's mitt is a padded rocket sled (1), the baseball a live shell (2), and the pitcher a 155-mm. howitzer (3), firing the shell along the track of the retreating target. As the supersonic sled passes a triggering device (4), it trips a release that fires the gun, and the shell is caught (5) intact and undamaged. The game is being played for Army Ordnance on the 35,000-foot rocket-sled



Sounding for bacon. A sad-eyed pig here submits to ultrasonic waves to measure the thickness of fat on its back. British inventors call the machine safe, humane, painless, accurate and simple.

Dry-land "ocean." This 315-foot trough is being built by Bell at Chester, N.J., to test undersea phone cables. Water-filled and cemented over, it will duplicate temperature and pressure at 12,000 feet.



track at Holloman Air Force Base in New Mexico. Object: to recover the shell unexploded so ordnance men can study what happens to the fuse in free flight. Problem: to catch a shell travelling 1,650 feet per second in the sled moving 1,450 feet per second in the same direction—both faster than sound. Solution: siting the gun so shell trajectory would match the inclination of the ground. It works—every time.

In case of a flat. Here's a mechanical finger that warns of flat inner tires on trucks and trailers. Deflation presses the axle-mounted feeler, closes an electric circuit, and sounds an alarm in the cab.

Super-fast teletype. This electrostatic printer built by the Signal Corps and Burroughs takes messages at 3,000 words a minute, 20 times faster than you talk. It translates from coded tape.

There's a boom now in low-pressure oil burners and for good reason. Makers say their big merit is—

Saving 15% on Heating a House

By David X. Manners

THE demonstration convinced me. You had to see it to believe it.

The fuel was of a kind no self-respecting oil burner would touch. It came straight from a service-station pit—a dirty mixture of crankcase, transmission, and rear-axle drainings.

The man switched on the burner. It started up immediately. The flame was clean and hot. A look outside at the chimney revealed no evidence of smoke.

Then the man began spilling water into the oil line.

The burner didn't falter. It took the abuse in stride. It gulped slugs of water that would have left an ordinary burner sputtering into gassy extinction.

But this was no ordinary oil burner. It was a low-pressure burner—a type you're going to be hearing a lot about.

While sales of other oil burners were dropping 20 percent last year, low-pressure burners were setting new records.

They've been well tested. Some types of low-pressure burners have been on the market over 35 years, though only in the last 10 have they been making a determined bid for the small-home market. They're called "low-pressure" because oil is pumped through them with a gentle push—as weak as 1½ pounds per square inch, in contrast to more than 100 psi in standard high-pressure burners.

Burning low-grade oil is not the low-pressure unit's chief claim to fame. Its most attractive feature is that it can also shave 10 to 15 percent or more off your yearly heating bill. There's only one hitch. It has been the reason why the low-pressure burner hasn't won wider acceptance so far.

It costs more to buy. How much more? To put it bluntly, exactly twice as much. A regular high-pressure burner costs about $80. The low-pressure job asks $160. But if you have an average house, you can make up that added $80 in the savings you get in the first three or four years. After that you'll be turning a yearly profit.

The high cost also goes down relatively when you consider the other elements you need. If you're buying a complete installation, including furnace or boiler, the low-pressure unit will add only about 15 percent to the total expense.

Europe, never famous for squandering, has taken to the low-pressure burner in a big way. It's the only kind of burner that will successfully handle their lower-grade oils. Also, Europeans consider 60 to 65 degrees as good heat, and the low-pressure burner is the only one that can be turned down that low and work well.

In this country, low-pressure units have had an uphill struggle. Most builders are too price-minded to use them. The heating plant has never been a place for them to add costly extras.

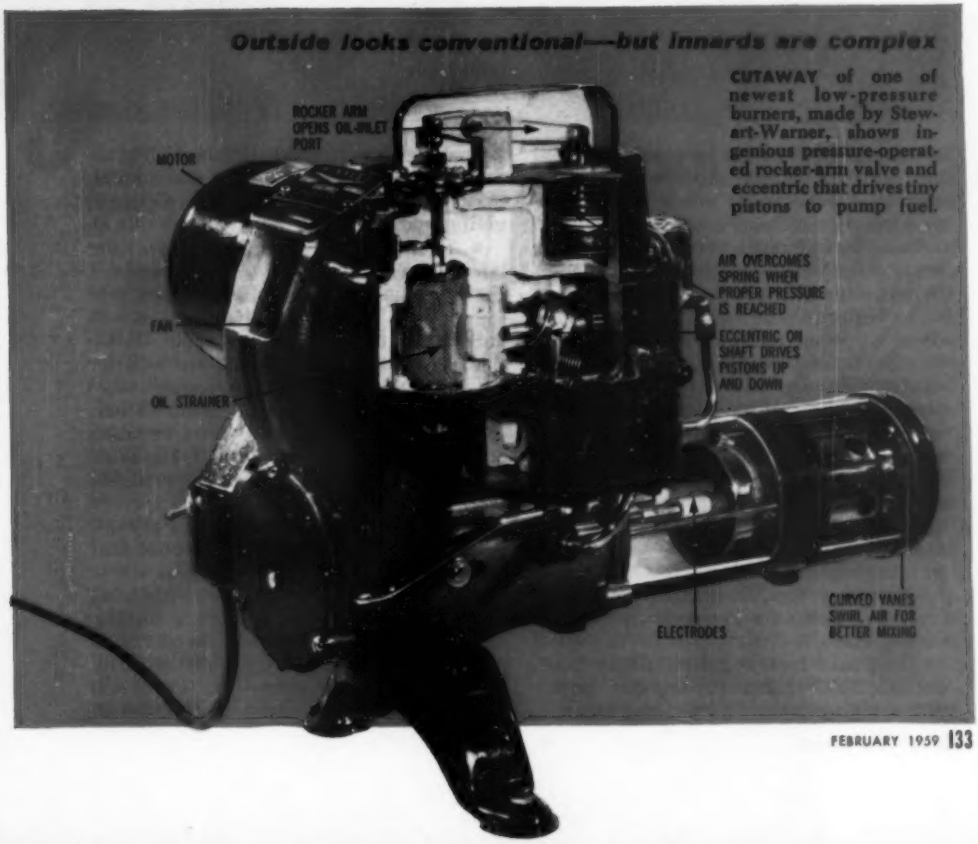
Why it's better. From the outside, a low-pressure burner looks very much like its high-pressure cousin. It has the familiar long blast tube that extends into the combustion chamber. It has a motor that runs a fan and a fuel pump. It has a transformer to provide high-tension current for the electrodes that ignite the fuel.

But it differs in these important ways: In a high-pressure burner, the oil doesn't mix with air until it comes out of the nozzle. At that late moment, a perfect mixture is impossible. In a low-pressure burner, oil and air in accurately metered amounts are intermixed before they reach the nozzle. The amount of air mixed with the oil is small compared to the total required to support combustion, but it's enough to envelop the fuel particles completely so that they burn with superb efficiency.

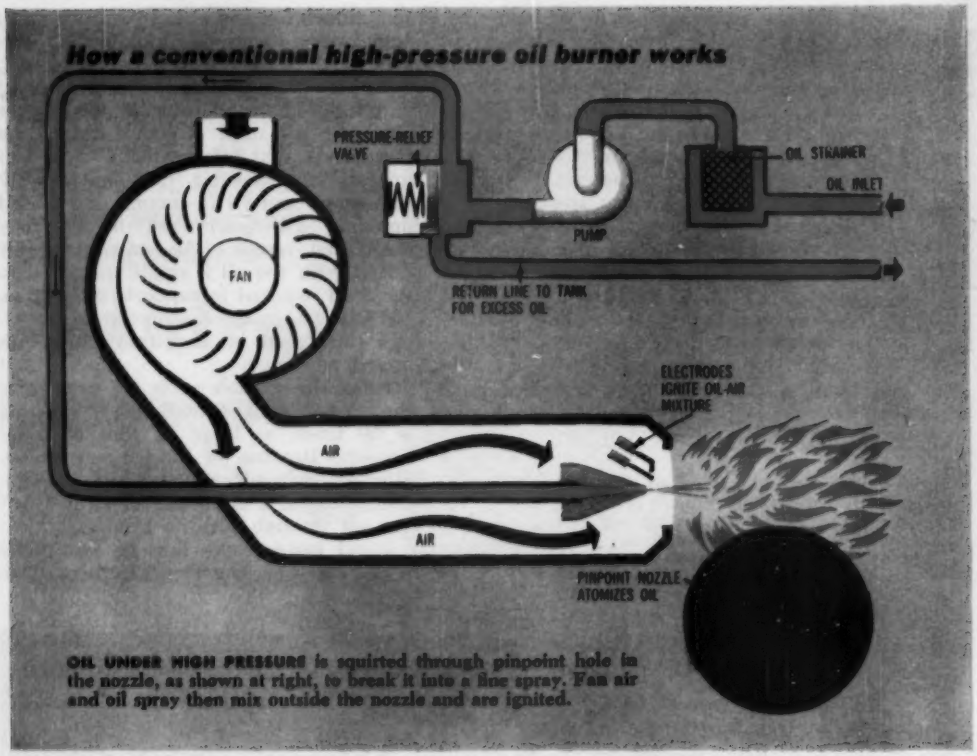
Since the nozzle's job is not to atomize the oil but to shape the flame, its opening is 30 times as large as that of other burners. Because of the large opening, filtering isn't as critical as on a high-pressure unit. Particles as large as 1/16″ can get through with no trouble.

Good low-pressure burners cost more because there is much more to them. Con-

DURING TEST FIRING, at left, low-pressure burner battles dirty, low-grade fuel, water, other abuse, and still produces a clean, white-hot flame. Tank above burner, used only in tests, stores small amounts of fuel.



CUTAWAY of one of newest low-pressure burners, made by Stewart-Warner, shows ingenious pressure-operated rocker-arm valve and eccentric that drives tiny pistons to pump fuel.



OIL UNDER HIGH PRESSURE is squirted through pinpoint hole in the nozzle, as shown at right, to break it into a fine spray. Fan air and oil spray then mix outside the nozzle and are ignited.

trol is precise. The oil rate, mixing pressure and air volume are all adjustable, making it possible to adapt the burner to unusual or difficult conditions.

Some manufacturers have tried short cuts to achieve low-pressure benefits. Using a burner that's basically the same as a high-pressure unit, they merely added a special pump and nozzle assembly. Evidence indicates that the best burners are designed from the ground up specifically for low-pressure duty.

Is it for you? Low-pressure burners can be used with any boiler or furnace. Many are used as conversion burners, or to replace old, worn-out units. Though the biggest gain is made with burners having a capacity under 1½ gallons per hour, they come in sizes up to seven g.p.h.

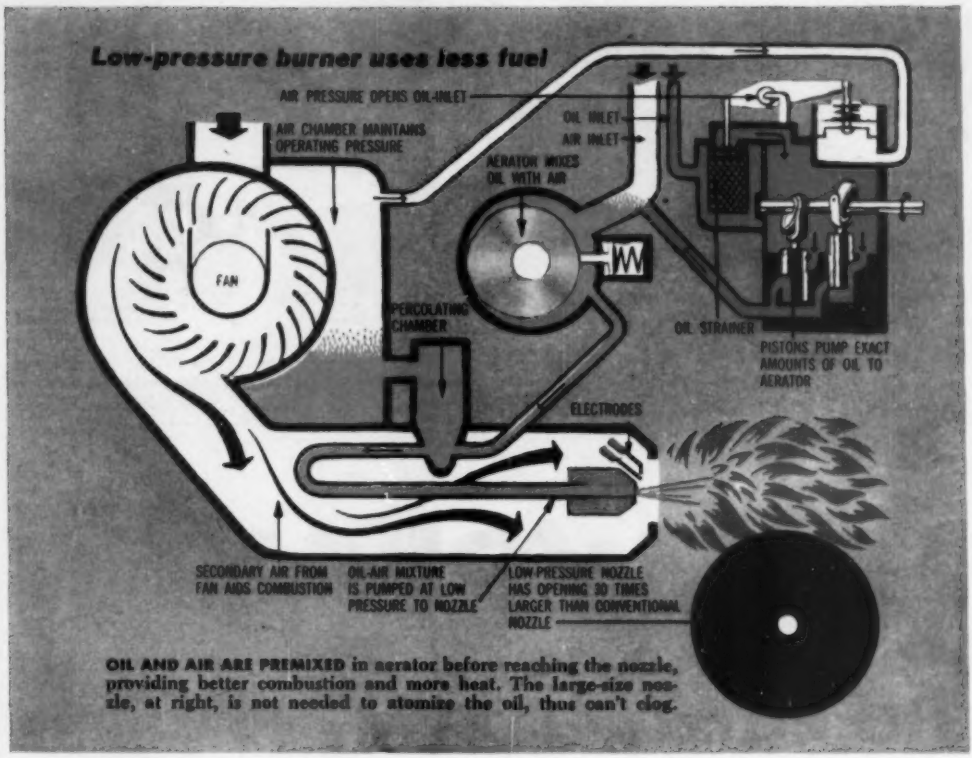
Before you buy. In making your decision for or against a low-pressure burner, consider these factors:

- *You save fuel.* A gallon of No. 2 oil contains 140,000 British thermal units. With a high-pressure burner, you can use 75 percent, or 105,000 of these BTU. A low-pressure burner, on the other hand, may reach 82 or 83 percent efficiency, giving you up to 115,000 BTU.
- *There's less waste.* A high-pressure burner may actually give you more heat than you need. The minimum firing rate for a good conventional burner is .75 gallons per hour, producing about 78,000 BTU per hour. Homes that are well insulated or located in mild climates may require less than this, so the rest is wasted.

A low-pressure burner, however, may have a firing rate as low as .375 gallons per hour. This means it can be made to give you as little as 42,000 BTU.

A low fire, burning over a long period, gives more even and more economical heat than a burner that stokes up a tremendous blast for just a few minutes, then cools off and loafs, waiting for the system to catch up. Frequent on-off cycles wear out your motor, use more electricity and cause more soot.

- *You need less servicing.* Almost 90



percent of service calls on high-pressure burners are due to clogged nozzles and strainers. The low-pressure nozzle, with its super-size openings, is practically immune to clogging.

Less pressure also means longer life. It eliminates one of the primary causes of fuel-line leaks.

• *It isn't fussy.* A low-pressure unit will burn any grade of domestic fuel oil, even "hard-cracked" catalytic oils which are finding their way into home tanks in increasing quantities. Hard-cracking eliminates the lighter side of oil, making ignition more difficult, but it poses no problem for the low-pressure's superior oil-air blending. Coming soon is a new low-pressure burner engineered to burn No. 4 oil —about three cents a gallon cheaper than the standard No. 2 oil.

In ordinary burners, variations in temperature and fuel viscosity can change the flow rate. In the low-pressure burner, the metering device stabilizes the flow rate regardless of oil viscosity or temperature. The burner works the same in all weather or with any fuel.

• *But it costs more.* With average savings, it will take you four years to get your money back. Statistics show that the average family moves every five years. If yours is one of these, you will gain some extra comfort, but probably not much in economy.

Be sure, too, that qualified servicemen and a source of replacement parts are readily available. Most conventional-oil-burner repairmen will not be familiar with the low-pressure job. Remember also that lower-grade fuels, while promising substantial future savings, are still a long way from reaching most home tanks.

Who makes them. At the moment, at least four companies are offering low-pressure burners for your inspection: Eureka-Williams Corp. (Oil-O-Matic), Bloomington, Ill.; Heil-Quaker Corp., Milwaukee; Herco Oil Burner Corp., Lancaster, Pa.; and Stewart-Warner Corp. (Winkler), Lebanon, Ind. END

SNOWPLANES WHIZ DOWN MAIN STREET like ordinary vehicles when winter snow hits Jackson, Mont.

THE SNOWPLANE

Homemade Blizzard on Skis

A heat lines up for the National Snow-

It flies 60 m.p.h. yet never leaves the ground. You can use one to race, hunt coyotes, go ice fishing or reach a ski slope

By Ed Christopherson

A SNOWPLANE is a ski-mounted, propeller-driven contraption that resembles nothing so much as a ski-plane that's never sprouted wings. When the snow's not sticky, you can speed cross-country over the white landscape as fast as 60 m.p.h., leaving a wake of swirling snow that glistens in the frosty sunlight.

It's simple to run—the only controls are the steering wheel and throttle. While driving or riding in one, it's easy to imagine yourself in an airplane that's continually straining to take off.

It's also easy to get hooked by snowplaning, enough so that you begin thinking of buying or building one of the rigs for yourself. Snowplanes are by no means limited to the high-mountain country of the West—where they provide fast, practical winter transport. Snowplaning is a fast-growing sport in many parts of the U. S. But before you rush to build one, remember that you need heavy, durable snows to make a snowplane pay off in fun.

A snowplane is a simple machine. Basically, it consists of a motor-driven prop mounted on skis, a place to sit, and a method of steering. John Krause of Jackson, Mont., is credited with building

plane Races, held every March. Races attract about 35 craft, many marked with ranch brands.

Biggest snowplane holds nine. Its pusher prop is turned by a 245-hp. Continental engine.

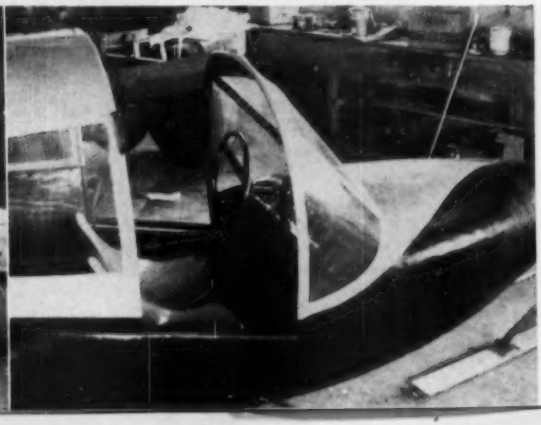
Covey of snowplanes gathers at start of a coyote hunt. Ship in center has an open cockpit.

the first snowplane in the West in the early '30s. On his first try, he mounted a Liberty engine on a bobsled and took off. Because he had no effective method of turning, his rig soon piled up against a jack-rail fence. His next try looked like a prop-driven pipe rack on skis, with a Model-A Ford engine and a motorcycle handlebar to steer with. It worked, but the weight of the engine limited its use to slick-surfaced roads. Airplane engines weigh, per horsepower, about a third that of their automotive cousins. So on his next try, Krause bought, for $75, an engine from a plane that had crashed nearby. He's stayed with aircraft power ever since.

Within the basic requirements of the snowplane, there's lots of room for variety and ingenuity. In the Big Hole country of Montana you can find snowplanes that range in size from a 65-horsepower, one-place open ship, started by hand-winding, to a nine-place enclosed leviathan powered by a 245-hp. Continental engine. The average ship, however, is an enclosed two- or four-placer with a 145- to 190-hp. power plant.

PLEXIGLAS WINDSHIELD is fixed to a framework covered with translucent aircraft fabric.

LATEST MODEL has a fiber-glass body, auto-type steering gear, instrument panel, sliding top.



Out on a fish-fry excursion, snowplaners eat brook trout caught through the ice on a lake.

The Banks-Maxwell Co., Box 3301, Fort Worth, Tex.—the outfit that makes the biggest share of the broad-bladed pusher props used on snowplanes and airboats—includes in its catalogue a set of blueprints for a simple but chunky-looking version of the snowplane. Most builders, however, want to design their own. The important factors in snowplane building are lightness and proper distribution of the minimum essential weight. Skis are usually made of full one-inch-thick hickory, steamed or boiled and bent on the leading edge. On a typical ship weighing 750 pounds, three nine-foot-long, five-inch-wide skis carry the weight nicely. For better tracking, some builders bolt inch-by-half-inch mild-steel strip, or strips, along the ski bottoms.

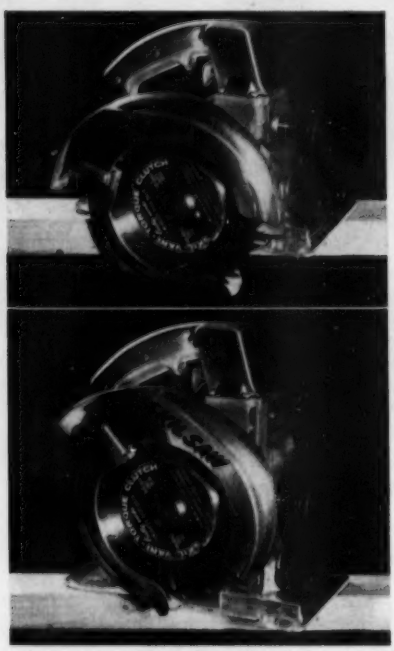
The body is built literally from the ground up, beginning typically with a rough outline of the ship chalked on the shop floor. The aircraft-tubing body skeleton is acetylene-welded, piece by piece, onto the front steering column and back axles. The floor, usually ⅜-inch plywood, is fastened to the bottom of the

[*Continued on page 256*]

ON FIRE DUTY, this machine sports wheels. It sucks flames away from burning buildings.

EARLY SNOWPLANE—a pipe-rack frame steered with handlebars, powered by a Model-A engine.

what's new

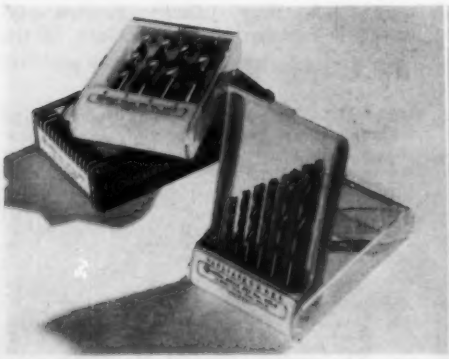


NEW PORTABLE CIRCULAR SAW has a pivoted guard that keeps front edge of blade covered at all times. The guard, horizontal at maximum blade depth (top photo), tilts forward as blade is raised to minimum cutting depth (lower photo). Skil Corp. makes it.

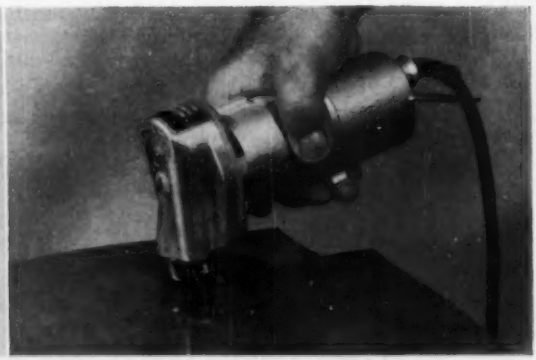
the latest in tools

New type of try square has an adjustable blade that automatically snap-locks into any of three angles—90, 45, and 22½ degrees. The pivoted blade can also be set at any other desired angle by tightening a lock nut. Strait-Line Products sells the tool for $4.80 . . . Indicating the importance of precision hand tools, Sears, Roebuck has added a super-accurate miter box to its line, priced at about $25. It features a one-piece milled bed and back, calibrated scale and automatic stops at all popular angles up to 45 degrees, left or right.

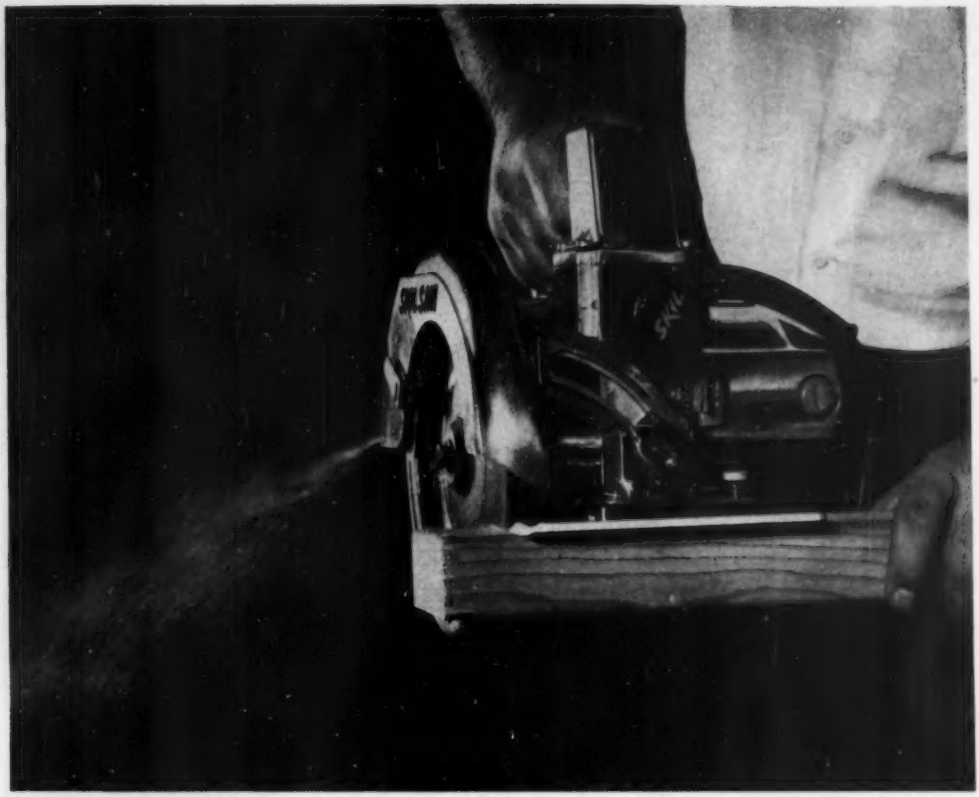
You can tune and repair your own outboard motor with a special 36-tool kit wrapped in a waterproof roll-up case. Included are point files, gap gauges, a spark-plug wrench, pliers, screwdrivers and an outboard instruction manual. Price is $9.98 from Penens Tool Corp. . . Small, portable heat chamber turns any home-shop soldering torch into a fiery furnace. With it, you can anneal and braze metals in concentrated heat up to 2,000 degrees. Production Engineering sells the 6", 8½-pound furnace for $14.50 . . . Watch for files with colorful, molded-on plastic handles. The Nicholson File Co. is test-selling them in some stores for 10 cents more than equivalent files without handles.



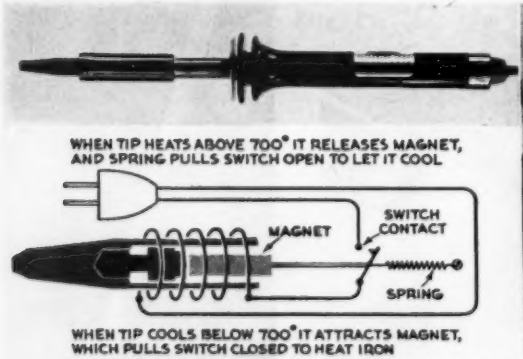
PLASTIC DRILL CONTAINERS form their own stands when you fold the covers back as shown above. Columbia Drill Co. sells five sets of high-speed and masonry bits up to ½" diameter.



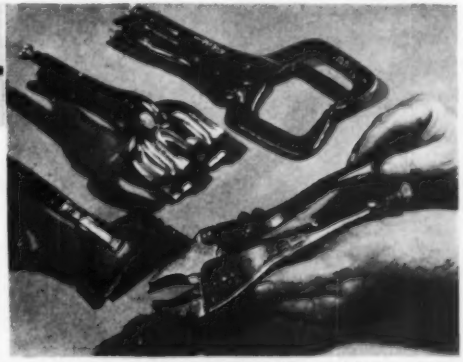
FAST-CUTTING ELECTRIC SHEAR slices sheet metals up to 1/16" thick at speeds up to five feet a minute. The Swiss-made Lesto tool is sold in this country by Krieg, Inc., for $79.50.



CHIPS FLY FROM SPECIAL EJECTOR on Skil's new portable saw (also shown on opposite page). A curved chute inside the blade guard throws sawdust out sideways, away from the operator. Also new is a pushbutton shaft lock that speeds blade changing. Skil sells the saw in a 7¼" model for $99.50 and an 8¼" size for $115. Both develop two hp., turn at 7,000 r.p.m.

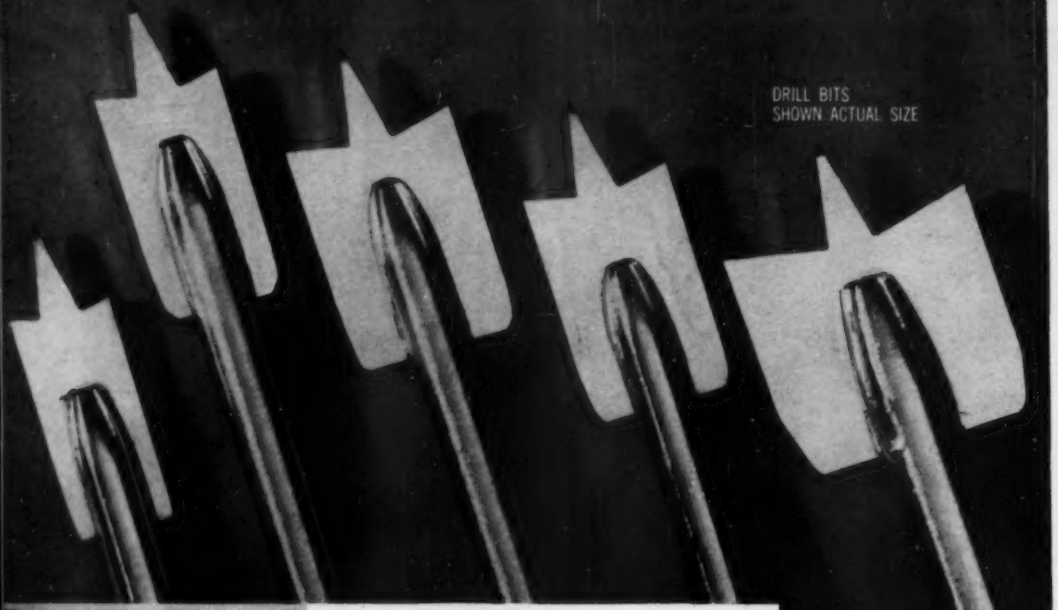


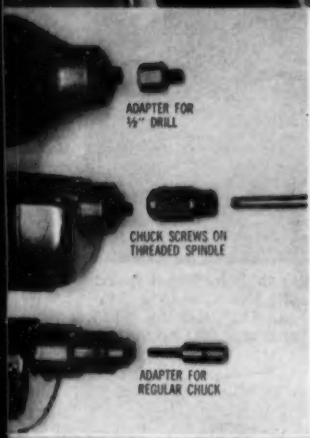
THERMOSTATIC SOLDERING IRON, said to be the first, has magnetic switch to turn it on and off for you, keeping heat constant. Weller sells 40-, 60- and 120-watt models for $8 to $10.50.



QUICK-RELEASE LEVER has been added to Vise-Grip pliers and clamps. It lets you loosen their one-ton grip with light thumb pressure. Peterson Mfg. Co. prices them from $2.15 to $3.35.

More new products on the next page





new quick-change chuck takes jumbo drill bits

YOU CHANGE DRILL BITS IN SECONDS with a new type of chuck just announced by Millers Falls. Special extra-large bits, made to fit the chuck, are simply slipped in, as shown below, and a spring-loaded collar on the chuck locks them tight. The chuck, priced at $1.75, will fit any ¼" or ⅜" electric drill having a ⅜"-24 threaded shaft. With adapters, the bits can also be used in ½" drills or in conventional drill chucks. Eight bits from ⅝" to 1½" are available for $1.65 to $2.50 apiece, plus, for extra-long reach, a 14" drill extension priced at $2.50.

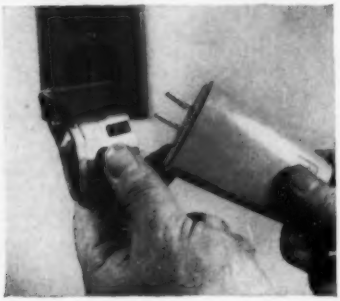
NEWEST 8-MM. MOVIE CAMERA tells you whether there's too little light, too much or just enough. As you sight through the viewfinder, you see the pointer of a built-in exposure meter alongside the image. You just adjust the exposure knob to keep the pointer centered. Eastman Kodak sells the single-lens Brownie shown for $79.50, a three-lens turret model for $99.50.

what's new for your home

Brush-on roof coatings, in the news lately, have a new entry. Montgomery Ward has announced a rubber emulsion coating said to restore and waterproof old asphalt-shingle and roll roofing at less than half the cost of a regular reroofing job. The roll-on paint comes in four pastel colors for about $6 a gallon . . . Motorized lounge chairs, also popular these days, have added a new trick, too. A new type by Niagara not only massages you but soothes you with heat as well.

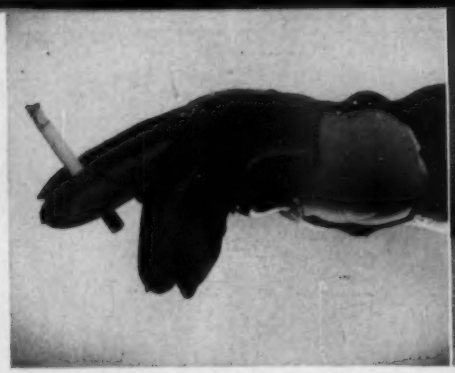
You can convert old ceiling lights to modern fluorescents with a circular fixture, said to be the first of its kind. The fluorescent unit screws directly into any standard socket. Satellite Fluorescent Fixture Co. sells it for $10.95 . . . Also new are super-thin fluorescent fixtures made especially for mounting under kitchen cabinets. Only 7/8" thick, they're sold in 12½" lengths by Alkco Mfg. Co. for about $13 apiece.

SPACE-SAVER for a kitchen or dining nook swings out from the wall to provide a four-place table and two benches (top photo at right). Folded up (lower photo), it protrudes only 4½" from the wall. Made of plastic-topped steel, the entire unit is held by four screws. The Lau Blower Co. sells it for $175.



RECHARGEABLE FLASHLIGHT at left never needs new batteries—you just plug it into any 115-volt outlet overnight for a fresh charge. Made by Culton Industries, it sells for $5.95 with nickel-cadmium battery included.

More new products on the next page



A FOAM LINING is said to make this the warmest finger glove in existence. Curon foam, made by Curtiss Wright, insulates the cold out. Tailoring is by Benjamin Harrison Weiss, Inc.

SIX CELLS OPEN AT ONCE for checking and filling when this vented manifold plug is snapped off. Lucas Electrical Services distributes the battery in the United States.

what's new for the family car

FREE-WHEELING HANDLE spins without operating the door latch to keep children safely inside the car. The universal handle fits most cars, and any car key sets it to open or to free-wheel. Faucher and Sons, Ltd., distributes the handle.

If you run low on gas, you'll hear about it with a $14.95 electronic unit called Gas Check installed under the dash. A buzzer having a "pleasant but insistent sound," according to Selectronic Sales, goes on when only two or three gallons remain in the tank, and continues until the ignition is shut off or the fuel supply replenished . . . A $1 plastic bib to keep your battery from drooling acid all over itself is made by Dietz Co. It fits snugly around filler plugs and terminal posts.

There's no straining with a foot-operated pedal that pushes sticking or frozen overhead garage doors effortlessly upward. Marman Co. sells it for $4.95 . . . Owners of Volkswagens and Dauphines can buy a can containing precisely one crankcaseful of oil. The White & Bagley 2.5-liter package does away with the annoyance of opening three quart cans to obtain the 2⅝ quarts needed for the little imports.

You can break down in style with new red flasher lights made by Cable Electric Products and A. G. Busch & Co. Both lights plug into the cigarette-lighter socket and have suction-cup bases for roof-top mounting. Caution: Don't drive with one flashing on your roof; you're likely to be arrested for impersonating a police car.

Sheldon Gallager

for more information:

Here's where to write if you can't get any item listed: **Alkco Mfg. Co.,** *6242 No. Lincoln Ave., Chicago;* **Benjamin Harrison Weiss, Inc.,** *259 West 30th St., NYC 1;* **A. G. Busch & Co.,** *6138 N. Northwest Highway, Chicago;* **Cable Electric Products, Inc.,** *234 Doball St., Providence 7, R. I.;* **Columbia Drill Co.,** *423 West Ontario St., Chicago;* **R. E. Dietz Co.,** *225 Wilkinson St., Syracuse 1, N. Y.;* **Eastman Kodak Co.,** *Rochester 4, N. Y.;* **Faucher & Sons, Ltd.,** *2055 Pie IX Blvd., Montreal 4, Canada;* **Gulton Industries, Inc.,** *Metuchen, N. J.,* **Victor J. Krieg, Inc.,** *611 Broadway, NYC 12;* **Lau Blower Co.,** *2027 Home Ave., Dayton 7, Ohio;* **Lucas Electrical Services, Inc.,** *501 West 42nd St., NYC 36;* **Marman Co., Inc.,** *32 Tomlin St., P. O. Box 6, Waltham 54, Mass.;* **Millers Falls Co.,** *Greenfield, Mass.;* **Montgomery Ward & Co.,** *619 W. Chicago Ave., Chicago;* **Niagara Therapy Co.,** *Adamsville, Pa.;* **Nicholson File Co.,** *Providence, R. I.;* **Penens Tool Corp.,** *Schiller Park, Ill.;* **Petersen Mfg. Co., Inc.,** *DeWitt, Neb.;* **Production Engineering Co.,** *Garnet Lake, Johnsburg, N. Y.;* **Satellite Fluorescent Fixture Co.,** *334 Third Ave., NYC 10;* **Sears, Roebuck & Co.,** *925 S. Homan Ave., Chicago;* **Selectronic Sales, Inc.,** *2421 Westchester Ave., NYC 61;* **Skil Corp.,** *5033 Elston Ave., Chicago;* **Strait-Line Products,** *P. O. Box 577, Costa Mesa, Cal.;* **Weller Electric Corp.,** *601 Stone's Crossing Road, Easton, Pa.;* **White & Bagley,** *Worcester, Mass.*

What We Now Know About SKIDDING

A four-way attack—involving roads, tires, brakes, driving techniques—promises tighter control over your car in slipperiest weather **By Martin Mann**

THE weather was clear, the road good, traffic light. The car was new, and the driver said, "I'm gonna see what this job can do." What it did was break away on an unbanked curve.

That driver didn't know enough about skidding. The road was not icy or even wet. But he didn't match his high speed against road grip and centrifugal force on a flat curve. And he didn't consider what would happen if a wheel hopped on a bump or pebble. So he's dead. (His passengers told the story.)

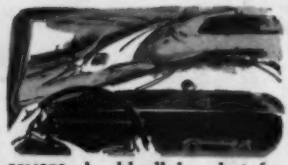
You can skid on any road, in any weather. You probably have. The important point is: Lots of things can be done to prevent it. Some involve driving techniques, others the construction of the road and the design of the car. Now it appears that many of them will be done.

A file-full of technical papers presented recently at the First International Skid Prevention Conference at the University of Virginia is a tipoff to what's cooking.

- Tricks for handling wheel and brakes in slippery weather are being pinned down by careful tests.
- Tires that grip better, even on ice, will be on sale next year.
- Brakes that can prevent skids are now in prospect.
- A warning signal—light or buzzer—to red-flag you just before

These tips on driving technique, say the experts, will prevent

REFLEXES work wrong in a skid. Hold back on sudden, violent actions until you can think.



SENSES should all be alert for danger. Look well ahead, feel for feedback clues from the car.

SPEED of the car should match the friction available for turning, accelerating and stopping.

the wheels slew sideways is another likely accessory.

- Sandpaper-surface roads will be common. Special treatments that make roadtops stickier yet are already being used on bridges and skid-causing curves.

Skidding accidents are increasing. In Virginia, skidding was involved in 41 percent of all accidents in 1957, against 35 percent the previous year. In England, where careful records go back many years, skidding accidents have risen steadily. (Probable reason: faster cars on faster roads.)

The figures on wintertime accidents on the Pennsylvania Turnpike show how serious a hazard skid conditions pose. When the Turnpike was icy, the passenger-car accident rate leaped to more than five times normal.

Why you skid. Your car moves and steers because friction between the road and the tires keeps the tires from slipping —they roll on the road. This friction goes down, way down, if something separates your tires from the road—the tire surface no longer touches the road surface solidly.

The something can be a bump that lifts the wheels off the ground. Most often, though, it's water (from rain or melted ice). A thin film coats the road, acting as a lubricant between the tire and road surface. Other liquids occasionally cause trouble—oil bleeding from asphalt pavement, for instance. One time out West, juice from millions of mashed locusts triggered a slither of skidding accidents.

The difference a little water makes is fantastic.

- On dry concrete, you can stop in around 20 feet from 20 m.p.h.
- On wet concrete, you need around 30 feet (50 percent more) at 20 m.p.h.
- On wet ice, you need between 200 and 250 feet!

Why you skid sideways. When you skid in a turn, you can blame centrifugal force. The road-tire friction has to be strong enough to resist centrifugal force; if it isn't, the car just takes off, wheels sliding.

The sideways skid on a turn isn't such a shock as a slew or spin when you're bouncing merrily straight ahead or braking for a stop. That happens because the road-tire forces are never quite the same at all four wheels—at each point of contact the road is a little different, the tires are a little different, braking action is a little different. This imbalance means that the total force is greater on one side of the car than the other, and that makes the car twist around its center when it slips.

You can't steer when you skid because a sliding wheel moves just as easily one way as another.

What you can do. People in Alaska, Saskatchewan and Maine don't put their cars up on blocks for the winter any more, and they don't all drive like your maiden aunt, either. There are tricks for skiddy driving. Here are six from the experts:

1. Rein your reflexes. You can't automatically twist the wheel or slam the brakes, the way you usually do, to squeak out of a tight spot. That can be exactly the wrong move. This is hard to remember, yet it's the most important trick.

2. Keep all your senses alert. Look for slick pavement where you don't expect it or where it is extra dangerous (at turns and intersections). Feel with a safecracker's fingers and a tightrope walker's toes for feedback clues from wheel, brake and accelerator. They can warn of loss of control. And don't ignore your stomach—there's a special deep-in-the-guts sensation that tells you just as you start to go sideways.

most skids and help you pull out of unavoidable ones safely

TURNS are best started tight. Then if rear wheels break away you have room to drift outward.

BRAKE hard without locking the wheels. A "fanning" motion, rapid pumping, is best on ice.

CAR with bald tire or uneven brakes is unbalanced. Experiment carefully to see effect.

3. Match your speed to the available friction—for turning and accelerating as well as stopping. Every action must be gradual, which means you have to give yourself space to maneuver.

4. Start your turns tight, the way a racing driver does. This gives you room to open up if the rear wheels break away.

5. Brake as hard as you can *without locking the wheels.* On ice, try "fanning"

What Kind of Tire Grips Best?

Ratings, based on National Safety Council tests, compare performance of each type to performance of standard highway tire. A rating above 100 means performance is better than a highway tire's; rating below 100 means performance is poorer than a highway tire's. The higher the rating, the better.

TIRE	ON ICE			ON PACKED SNOW	
	Driving Traction (drawbar pull)	Braking (stop from 20 m.p.h.)	Cornering (turning 400-ft. circle)	Driving Traction (drawbar pull)	Braking (stop from 20 m.p.h.)
Standard tire	100	100	100	100	100
Standard tire with holes punched in tread	157	120	109	134	128
Standard tire with slits cut across tread	147	111	106	140	123
Mud-snow tire (knobby tread)	105	100	102	126	129
Mud-snow tire (continuous bold tread)	140	122	106	171	133
Special tread with wire-coil insert*	172	111	110	147	116
Standard tread with salt embedded	123	111	107	107	106
Standard tread with peanut shells embedded	96	101	101	73	90
Standard tread with sawdust embedded	100	103	—	89	99
Standard tire with round chains	331	197	—	—	130
Standard tire with reinforced chains	509	253	—	413	158
Standard tire with sanders	370	116	—	132	100

**A product of Penetred Corp., Marshfield, Wis.; other tires are available under many brand names.*

—fast brake-pumping that locks and unlocks the wheels. Some experts think this can shorten stopping distance by 15 percent and keep the car steerable.

6. Beware of one bald tire or uneven brakes.

Such tricks are second nature to good drivers in cold-weather areas. But over most of the U.S., bad skid conditions are so infrequent that most drivers lack the chance to perfect special skills. Their inexperience leads them into trouble.

This accident (a real one) is typical: Four cars are feeling their way along an icy, four-lane expressway.

Number two decides to pull out and pass. But he's too rough with the steering wheel or the accelerator. He spins.

Number three could edge off onto the shoulder. He should. But he fails to control his reflexes, and hits the brakes instead. He slides into number two.

Number four makes exactly the same mistake and joins the wreck.

The importance of practice shows up in the statistics. On the Pennsylvania Turnpike, truckdrivers get into a few more accidents in slippery weather, but the increase is nothing like the fivefold change recorded for passenger-car drivers.

Tires that stop skidding. Whatever your skill and experience, the right tires help a lot. An amazing amount of skid resistance can be built into them, although chains, particularly reinforced chains, are still best for the roughest going.

The basic idea is simple: The tire should push away the very thin film of water coating the roadway to restore the high friction of solid-rubber-to-solid-pavement contact. That is what the tread is supposed to do: Its edges wipe the water out through the grooves.

This applies to ice-coated as well as rain-coated pavement. Ice is slipperiest when coated with water (often melted by the pressure of the tires). In snow, deep tire grooves improve traction by meshing with the snow itself.

A perfectly smooth tread is the worst kind—it traps the water film inside the tire footprint.

How much difference do tires make? Tests of the National Safety Council show that good mud-snow treads improve braking performance on ice by 22 percent (over regular road tires). And better designs are in the works. One maker is now testing a tire that promises a 50-percent gain in skid resistance.

These remarkable improvements come almost entirely from tread design. The basic construction of the tire doesn't seem to affect skid resistance one way or another. And until recently, the kind of rubber in the tire seemed relatively unimportant.

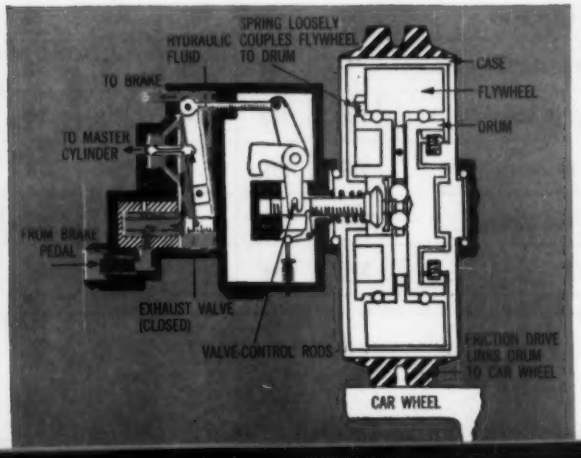
But now a physicist at Cambridge University in England, D. Tabor, has come up with a radical idea. He thinks the way to cut skidding is to use the "wrong" rubber in tires.

Ordinarily, tire engineers avoid rubber that heats up quickly from internal friction when it flexes (they call this "hysteresis loss"). The heat wrecks the rubber.

But Tabor's experiments show that this destructive internal friction is the source of most of rubber's resistance to sliding. Here is how he explains it:

When a tire slides, the tiny roughnesses in the road dig temporary grooves in the rubber. It takes work to plow these grooves. This work comes from the force making the wheel slide, and is used up in

[*Continued on page 260*]

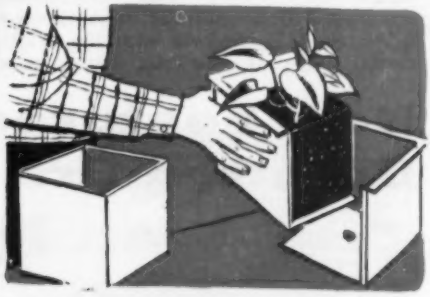


ANTI-SKID BRAKE automatically releases hydraulic pressure before wheels lock. British unit has drum and flywheel driven by contact with car wheel. If car wheel decelerates suddenly, ready to lock, drum follows, but loosely coupled flywheel slides around drum because of its inertia. Flywheel movement actuates rods that close hydraulic supply line and open exhaust valve, releasing brakes. When wheel unlocks, drum catches up with flywheel, exhaust closes, supply opens, brakes go on.

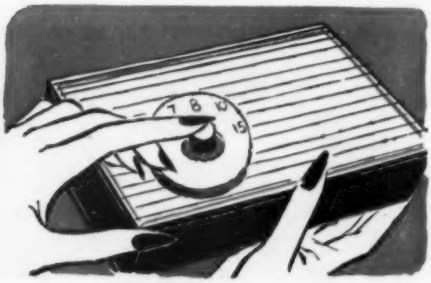
"I'd like to see them make..."

DUAL-PURPOSE HUBCAPS lined with red reflective material. Supported on a folding stand, the hubcap would warn off other motorists after dark.—*Frank Palmieri, Paterson, N. J.*

NO-PUMP GREASE GUNS for cars. They'd use gas cartridges for pressure. Add a grease-cartridge loading feature and you'd have a honey of a gun.—*Leon L. Morris, Baltimore.*



TAKE-APART FLOWER POTS. Big pots cost a lot and sometimes have to be broken to remove a plant for transplanting without damage to the roots.—*Mrs. Harley Utz, Vandalia, Ohio.*



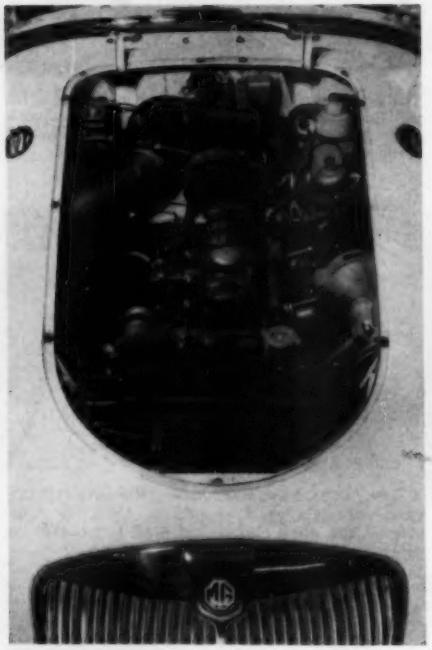
DIAL GUARDS FOR TINY RADIOS that get lots of handling. A push-in knob to lock or free the dial would prevent loss of the station setting.—*D. Pulaski, W. Springfield, Mass.*

A FINGERTIP BANDAGE about the size of the rubber fingers used in offices. Adhesive tape around the open end would hold it securely in place.—*Jane Maxwell, Tuscaloosa, Ala.*

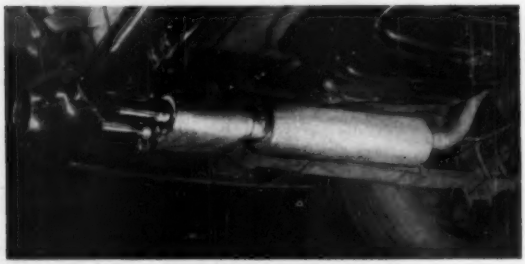
Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's *yours?* We will pay $5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

Egg-Shaped Bubble. This latest sedan among the Bond Minicar three-wheelers is designed to compete with the Continental styles. It seats four, delivers nine hp. through a four-speed gearbox mounted with the engine over the single front wheel. Both swivel as a unit for 180-degree steering to turn on a sixpence.

New Features and Gadgets Brighten British Roads



More Oomph for MGA. A new supercharger designed for the MGA (left) ups horsepower by a third to give the car a top speed of 100 m.p.h., claims the accessory's maker. Available as a bolt-on kit, the blower is said to enable an MGA to better performance of the "Twin-Cam" model [PS, Oct. '58] at less cost.



Booster on Exhaust. A hollow chamber with a venturi nozzle slips over the Vauxhall Victor's exhaust pipe, sucks in air to form an air lock and halt back pressure. The booster is said to cut four seconds from 0-to-60 time, increase gas mileage and give higher top speed.

Floor-Level Engine. This new Leyland fire truck has its 150-hp. diesel engine recessed in the chassis under the floorboards. The radiator is set over to one side. This leaves room at the front for pumps, hose connectors and controls so the machine can be taken straight up to a fire hydrant and quickly coupled to it. The underslung drive provides a low center of gravity for fast cornering.

Face-Lifting for TR3. You may not recognize the familiar Triumph TR3. Prototype for new model (right) sports a new body styled by Italian designer Michelotti. Features include slab sides, flared fins, hooded headlights and a wide-mouth grinning grille.

Four in a Berkeley. Latest version of the fiberglass-bodied Berkeley seats four adults in dubious comfort. Its body shell is braced with light-alloy bulkheads and members to form a single rigid structure. It retains front-wheel drive, but is now powered by a 30-hp. engine through a four-speed gearbox instead of a 15-hp. plant and three-speed motorcycle gearbox.

You get 12 photos like this, shown actual size, on 127 film.

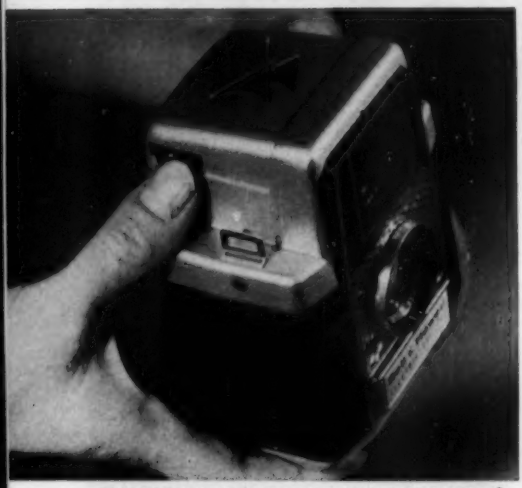
New Electric-Eye

YOU can point this camera, forget all about exposures, f/stops and light meters, and still come up with good snapshots.

Recently introduced by Bell & Howell, the new still camera measures the amount of light in any scene, tells you whether there's enough light to take a picture, then automatically sets the lens opening to the correct size. If there's too little light, a red warning flag pops up in the viewfinder; if the light is right, a green signal gives you the go-ahead.

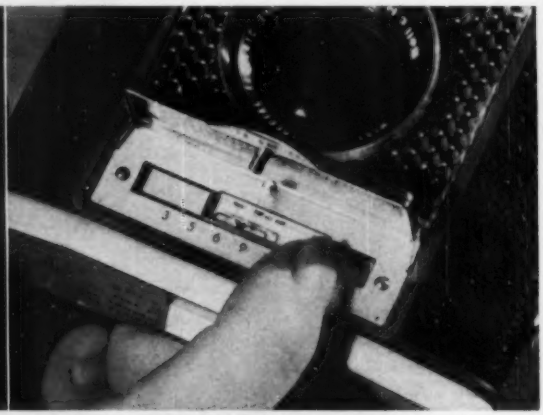
All this happens instantaneously—faster than the human eye can react to light—and you're ready to shoot. A tiny photocell, or electric eye, does the job. It generates a small electric current in proportion to the light it "sees." The current is fed to a miniature voltmeter which, instead of moving a needle, turns a gear linked to two overlapping, slotted disks. How far the meter gear turns determines the size of the lens opening.

A fixed-focus lens also eliminates the job of focusing. The film-advance knob cocks the shutter as you turn it, and a safety interlock makes double exposures impossible. Price of the camera is $79.95, including flashgun and case, from Bell & Howell, 7100 McCormick Rd., Chicago.



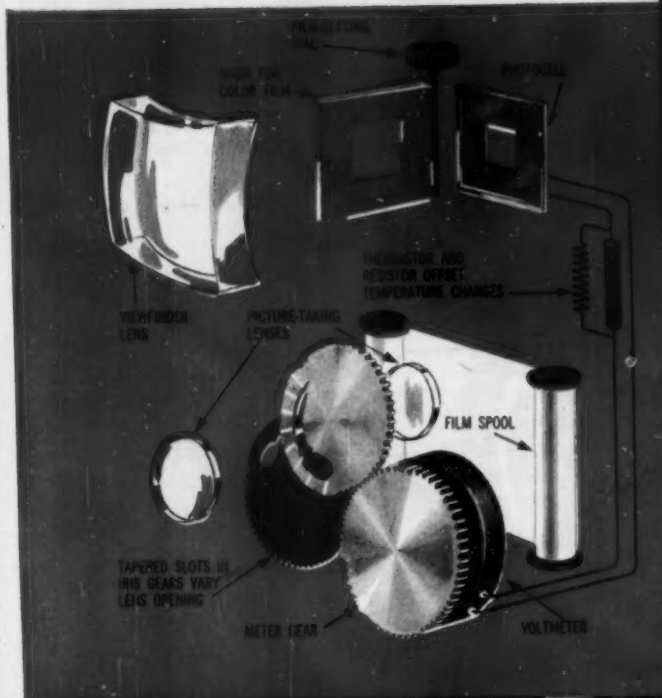
YOU SHOOT COLOR OR BLACK-AND-WHITE by simply flipping this dial. For color, dial swings a mask in front of photocell, forcing it to admit enough additional light to take picture.

FILM SPOOLS SLIDE OUT for easy loading outside of camera, then entire transport mechanism is pushed back in. Chart on base shows the correct flashbulb to use with each type of film.



THERE'S NO GUESSWORK WITH FLASH, either. For night or indoor shots, you set this slide to desired distance and it overrides photocell, setting proper lens opening mechanically.

Camera Takes Foolproof Snaps



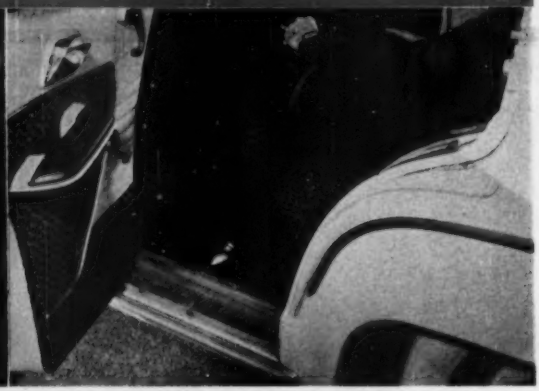
How the "eye" works

PHOTOCELL "SEES" LIGHT through viewfinder in photo below, at left, closing iris opening down to small hole. With viewfinder partly covered in photo at right, eye can't "see" enough light to take picture, and iris opens wide to let in more light. Iris opens or closes in same way when camera is pointed at dark or light scenes. Drawing at left shows how current from photocell drives meter gear, which varies size of opening formed by slotted iris gears. Mask at top partly covers photocell when color film is used to insure enough extra light.

A Close Look at SIMCA—Chrysler's Economy Car

SHARING THE CHRYSLER LIMELIGHT, this demure French four-door is expected to be the big seller in a lineup of eight Simca automobiles, including two 80-hp. V8s.

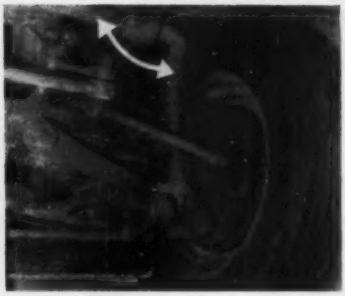
NEATLY TAILORED INTERIORS, with door panels matching upholstery, an instrument binnacle, and a nicely styled dash give the Simca considerable eye appeal. Two glove compartments, sun visors and a windshield washer are standard equipment on the Super De Luxe sedan.



RECTANGULAR STEEL CHANNELS welded to the chassis floor frame the passenger compartment. A good safety feature, these form step-down sills in the rear. Back seats and knee room are fine. But passengers must duck as they enter, and rear doors don't open as far as they should.

DIVIDED FRONT-SEAT BACKS are adjustable to several tilt positions, recline for on-the-way naps. During stops, with the seat cushion fully forward, backs can be laid flat to form a soft but rather short double bed (37 inches long, or 69 including toe space under the dash).

KINGPINS SWIVEL ON THREADS at the bottom, ball joints at the top. A stabilizer bar (arrow) levels out sway on curves. The universal behind the transmission (center photo) is a hexagonal rubber doughnut, absorbing engine shock and vibration. Rubber-mounted rear spring shackles require no lubrication. Overload springs (arrow, right) are provided on the wagon.



By Harry Walton

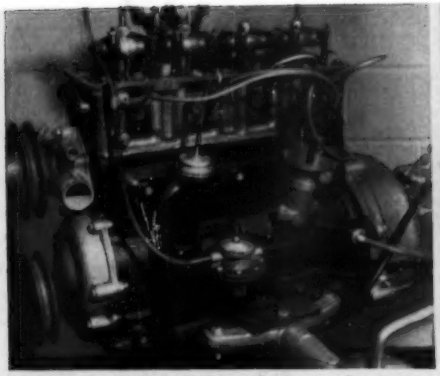
ELBOWING the Chrysler Corporation's high-powered automobiles on showroom floors you'll find its economy car, the saucy French Simca. The contrast between the two lines is enormous. The Simca is chic instead of flossy, demure rather than commanding, a tough, good-looking small car with a tender regard for fuel dollars. Its gadgets are strictly practical. Its horsepower, respectable for an import, would hardly run all the power options on a big V-8.

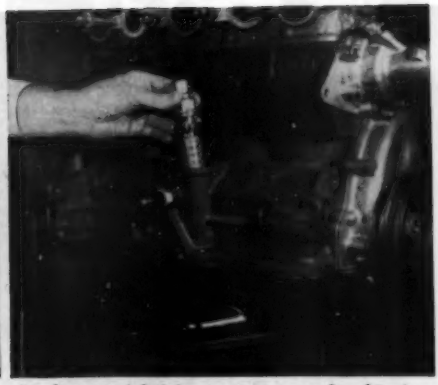
Top seller in the line is a frisky four-door sedan with a front-mounted four-cylinder engine, manual shift and conventional rear-axle drive. The low-priced De Luxe model unloads at East Coast ports for $1,698.

Its 96-inch wheelbase is two inches longer than the Volkswagen's, seven longer than the Renault Dauphine's. The Simca is roomier, especially in luggage space, than these two popular rear-engine imports.

It is also peppier, for the Simca engine checks in at 48 hp., and although about 500 pounds heavier, the car has a livelier power-to-weight ratio (42 lb. per horsepower) than the other two. With the "special" version of the same engine, in which compression is raised from 6.8 to 7.8 to 1, and horsepower to 57, it is even farther ahead.

The Simca is tough. A stock 1958 sedan with the 57-hp. engine snatched the cross-country record from an American V-8 about a year ago. Harry Somme and Frank Slater, of Denver, drove it from





STANDARD SIMCA ENGINE has an aluminum head only 13 inches long, with valve-seat inserts. The clutch and transmission housings are also aluminum. A lifetime brass oil filter (shown in photo at right) is easy to remove for cleaning. At bottom is the oddly shaped oil reservoir, welded to the lower crankcase shell. It's cooled by the flow of air underneath the car.

New York to Los Angeles in 46 hours three minutes, averaging 64 m.p.h. and 27 miles per gallon. The car used one quart of oil.

In Europe, a Simca was driven steadily for 38 days, rolling up a total of 63,000 miles at an average of over 70 m.p.h. It stopped only to get gas and oil, change drivers and tires. On the record, the Simca is definitely no cream puff.

Trying out a small car, I often wonder what it would be like to have it as my own and only one. The Simca would be no hardship at all. It is brisk in behavior and a delight to handle.

The almost-square Simca engine (2.91 inches bore, 2.95 inches stroke) has a displacement of 78.7 cu. in. and puts out 65 lb. ft. of torque at 2,800 r.p.m., a figure that gives the car A for effort in third and fourth gears. It lugs without a whimper if you insist, and takes hills at a pace that shames most small imports.

Its highway manners could give lessons to many a bigger car. Steering is fast but so precise you feel the car is always firmly in hand. Thanks to an uncommonly good assembly of suspension parts—coil springs, wishbones and leaf springs, plus a stabilizer bar in front—cornering is superb. Even on rough roads or after hitting a dip at a good clip, the car finds its footing without bouncing or scrabbling for traction.

In town traffic, I can wheel the Simca more deftly than my own V-8. As its 36-foot turning circle indicates, the car is highly maneuverable. Parking on a dime (or a 10-franc piece) takes just a fraction of the effort you expend in berthing a medium-size domestic car.

Third gear is high enough to step out smartly yet low enough to let you pick up from 15 m.p.h.—a very handy traffic gear. In fourth, which is straight through to the

[*Continued on page 264*]

THE CHATELAINE STATION WAGON has straw-woven upholstery and a let's-get-down-to-business air. With the rear seat folded down flat, the wood-slatted cargo deck is 55 inches long. An American-type tailgate makes it possible, however, to haul loads considerably longer than this. The Chatelaine has oversize tires and a governor limiting speed to 70 m.p.h.

Army's New Rifle Is a Machine Gun, Too

By Herbert O. Johansen

PHOTOS BY W. W. MORRIS

WHEN Master Sergeant and master rifleman Otto Hanel had fired a "mad minute" with the new lightweight M-14 rifle at the Aberdeen Proving Ground, Md., he gingerly patted the smoking barrel. "She sure is sweet," he drawled.

We walked 50 yards down to the cardboard target. Hanel had fired 76 rounds, semiautomatic, in 60 seconds. There were 74 holes in a tight pattern. Previously, using armor-piercing ammo, he had drilled quarter-inch steel plate.

Then, turning a lever on the stock to full automatic, he fired the rifle at the rate of 750 rounds a minute, from the shoulder, and from the hip. He put in another magazine and handed me the gun. I pulled

NEW 7.62-MM NATO CARTRIDGE (right) and U. S. standard .30-caliber—shown actual size. Powder charge is about the same.

By flipping a lever, a GI can fire it like a machine gun .....

the trigger. If he hadn't been there to prop me up from behind I would have been thrown flat on my back.

"Got a kick like Betsy, my old squirrel rifle," said Sergeant Hanel, a native of South Germany who acquired his Southern accent as a youngster in Georgia. He is one of the few soldiers who has handled, fired, or even seen the new M-14 rifle.

The M-14 is so new, in fact, that a manual of arms for the weapon has not been set up. The first of an order of 70,000 will come off the assembly line at the Springfield Armory, Mass., in June. It will be in the hands of troops next year.

Already, however, there are rumors in the field, with the usual misconceptions that accompany scuttlebutt. One is that the new gun is *very* much lighter than the M-1 Garand. That depends on point of view. To a weary infantryman a pound and a half may seem like a ton. The M-1 weighs 9.72 pounds, compared to 8.28 pounds for the M-14.

Then there is the impression that because the M-14 uses the NATO 7.62-mm. cartridge it is a NATO rifle we have adopted. The M-14 is strictly the result of U.S. Army development, begun during the latter part of World War II, to produce one standard rifle to replace a variety of shoulder weapons.

Independently, a few years ago, Fabrique Nationale of Belgium came up with a new rifle that was proposed as a standard NATO rifle. Some of them were made in this country and tested as the T-48. The Army decided to stick to its own gun. The M-14 is, however, chambered to take the shorter NATO cartridge. The 7.62 mm. is simply an equivalent of the good old caliber .30, and the new designation is a gesture to the international make-up of NATO, most of whose member countries use the metric system.

The versatility of the new rifle is shown by the weapons it replaces. Besides the M-1, it will make obsolete such former stalwarts as the carbine and submachine gun. With a heavier barrel to keep it from overheating and a bipod for stability, it will take over the shooting jobs of the Browning automatic rifle.

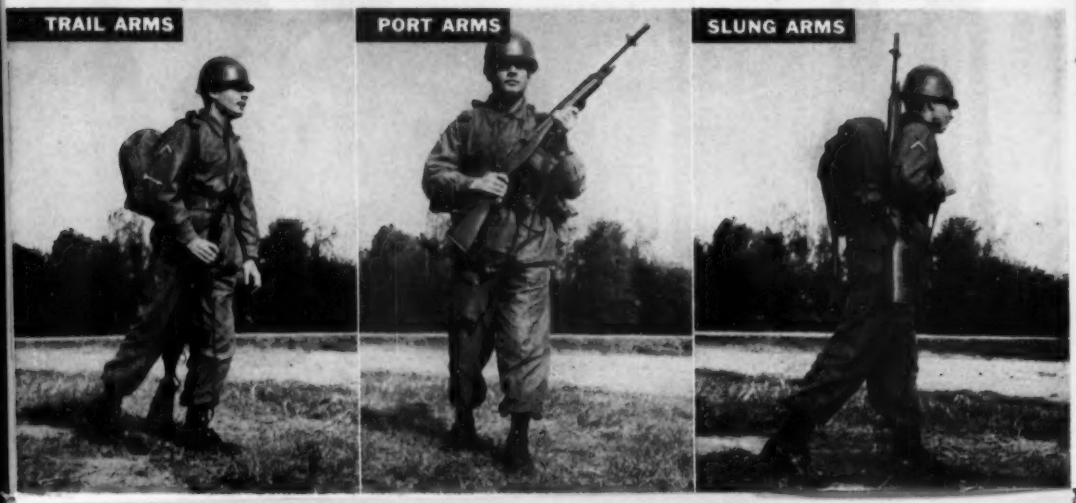
By putting an automatic weapon in the hands of every infantryman, the Army will have marched another step forward in the direction of getting the "mostest" shock power up where it can use it "fustest." World War II saw the development of the recoilless cannon, a midget small enough to be manhandled by a couple of doughty infantrymen but stout enough to blow large and deadly shells at the enemy. That put artillery on the line, in the hands of the man staring—often literally—at the face of the enemy.

It gave him artillery fire *now*, and relieved him of his total dependence on a system of artillery control that too often was slow and inaccurate.

In the same way, the M-14 gives the man on the line automatic fire *now*—in

Lighter weight makes the M-14 easier to carry

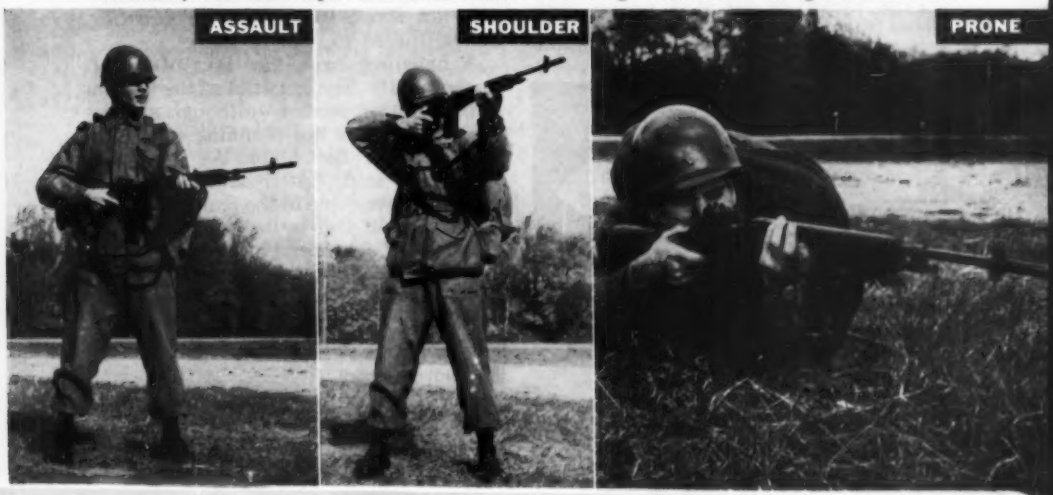
STANDARD CARRYING POSITIONS were demonstrated by GI who had never held an M-14 before. No manual is yet available, but handling will be like that of M-1, which it resembles.



MAJOR RIFLES THAT ARE IN USE by North Atlantic Treaty Organization (NATO) nations today are shown in the top row. These guns are from the Aberdeen Proving Ground Ordnance Museum. Six types of ammunition are involved. In horizontal position (top) is the Belgian Fabrique Nationale model using NATO 7.62-mm. cartridge, and (bottom) the U. S. M-14.

Better balance gets it into firing position faster

DOWNWARD-PROJECTING MAGAZINE and unfamiliarity with the weapon caused the soldier some difficulty in adjusting to various firing positions. Sgt. Hanel soon straightened him out.



Penetration fire pierces steel plate

LIGHTWEIGHT THE M-14 MAY BE, but loaded with armor-piercing ammunition it makes a monkey out of a square of tough steel plate. Range was kept to 50 yards for photographic purposes. At right is shown what five well-placed shots did to the piece of armor plate. At long distances the greater range of the streamlined NATO ammunition gives higher impact for penetration.

his hands as he moves forward in the assault, or on the parapet of his foxhole.

But won't a man run out of ammunition too quickly with a weapon that fires so fast? Answer: He will if he fires it enough. But this is only one problem. Of equal gravity to infantry tacticians is the problem of getting a man to fire the ammunition he has. Faced with a determined enemy, the green soldier may shrink deep into the false security of his foxhole. He may never fire a shot. An automatic rifle may help cure him. At the moment of decision when armies lock in battle, it may give him the weapons-confidence he needs to look down his sights and squeeze the trigger.

HEAVIER BARREL OF THE M-15 version (with bipod) is shown in this close-up of the business ends of both rifles. Projections at the muzzle tips are double-duty flash suppressors.

By flipping a selector lever, the GI has a choice between semiautomatic fire and automatic. On semi, as with the Garand, the trigger must be pulled for each shot. On automatic, you just haul back on the trigger and let her rip. In the dark, a projection at one end of the lever enables the soldier to tell his firing position by feel. If a company commander wishes, the rifles his men carry can be made to fire semiautomatic only. A conversion kit is available for this.

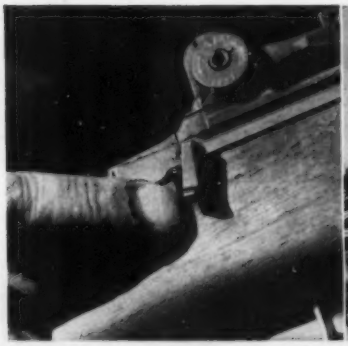
The M-14 is intended mainly for single-shotting—the automatic feature is for emergency use. For sustained automatic fire, its five-pounds-heavier brother, tabbed the M-15, will be used.

A hangover from the days of trench warfare is the bayonet stud at the bottom of the flash suppressor—although at present the Army is not planning to issue a bayonet with the M-14. As an Army spokesman said, "After several hundred years we have come to the realization that a rifle is not a close-in combat weapon and that we don't need a pike at its end."

The flash suppressor itself does more than break up flash that might draw enemy fire at night. It is a five-pronged device, with a wider prong at the bottom.

Shooting the "mad minute"

PREPARATION INCLUDED A LOT OF SQUIRMING into a comfortable position, and dry runs on the trigger before the first magazine was inserted. Then "Fire!" and a steady stream of bullets, broken by magazine changes, as a stop watch clicked off the seconds. Score: 76 rounds in 60 seconds, 74 hits. Small white card, removed from target center, was the aiming point.



Cartridges fly as the M-14 goes fully automatic

SELECTOR LEVER IS TURNED TO AUTOMATIC. Shoulder position. "Fire!" One pull-back of the trigger empties the 20-round magazine in 1.6 seconds. Note empty cartridge casings being thrown into the air. Sgt. Hanel, wearing his personal shooting jacket, expects to retire in about three years and return to the Army in a civilian job—shooting guns, of course.

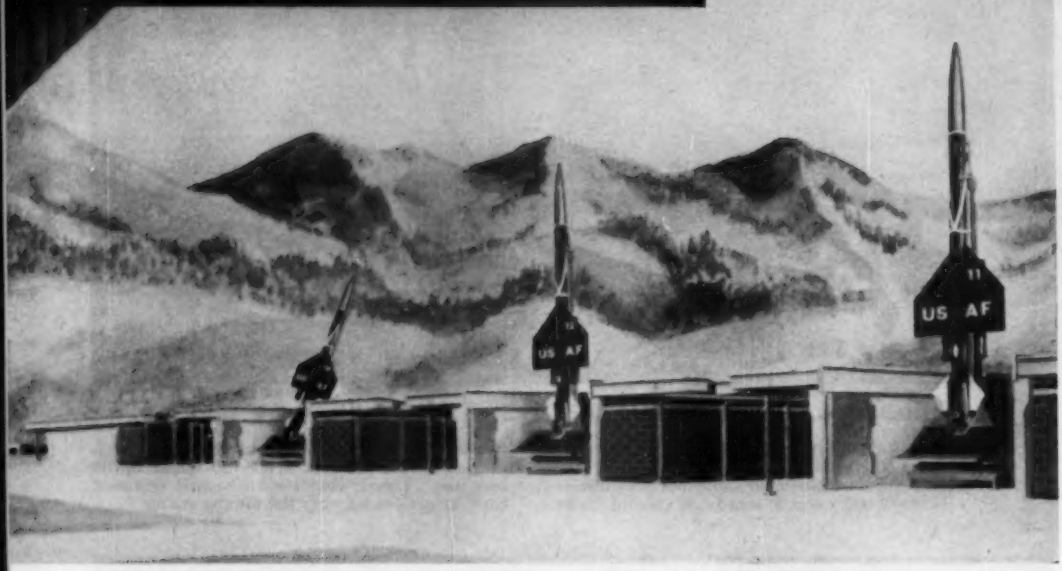
As the rifle is fired, gas thrusting against this wider prong tends to lessen muzzle climb, aiding accuracy.

Comparing the M-14, with the M-1, William C. Davis, Chief of the Aberdeen Proving Ground Small Arms and Aircraft Weapons Branch, pointed out:

- Because it is lighter and less muzzle-heavy, the M-14 is better balanced for carrying, handling and firing.
- Its bolt stud rides on a roller, reducing friction and eliminating the need for a special wet-weather lubricant.
- Muzzle velocity of the bullet is the same for both guns—2,800 feet a second. But the new rifle has a maximum range of 4,200 yards against the M-1's 3,500 yards. The greater range comes from the cleaner aerodynamic design of the shorter NATO cartridge. END

What's in the Air

PLANES · ROCKETS · MISSILES



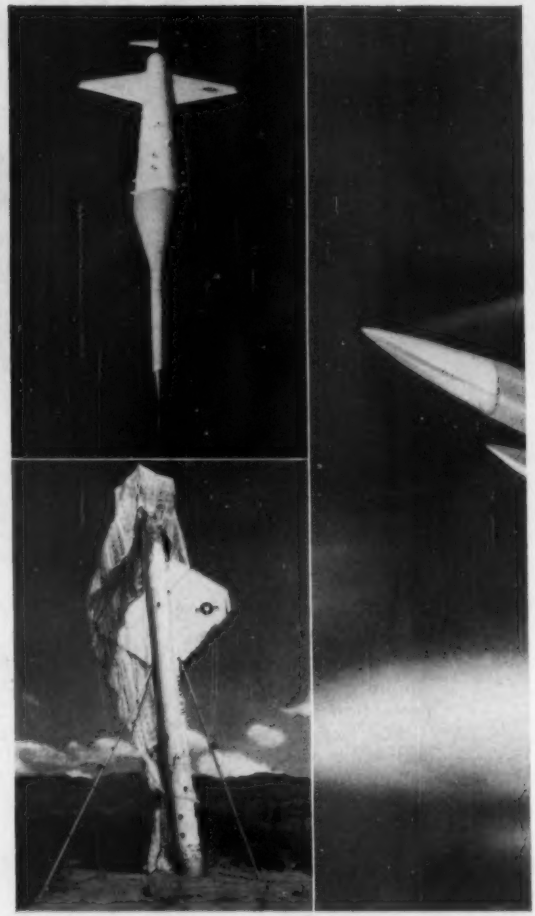
The Bomarcs are coming. A 300-acre base for launching Air Force Bomarcs—supersonic, ground-to-air nuclear-warhead missiles—is nearing completion at Suffolk County Air Force Base, about 90 miles east of New York City. Shown in the photo below, it will have launching pads for 56 of the slim, 47-foot-long, 400-mile-range Boeing interceptor missiles. Above is an artist's conception of a bank of firing units.

There will be 14 such sites strategically located on the Atlantic and Pacific coasts and along our northern border. One base can give cover-

age against enemy missile or bomber attack over an area of 500,000 square miles. This is called "area" defense, as against the more limited protection of the Army's Nike Hercules "point" defense.

The Suffolk Bomarc Base will have its own power plant, utilities and water wells. Underground tanks will store 20,000 gallons of propellant fuels, including 11,000 gallons of fuming nitric acid.

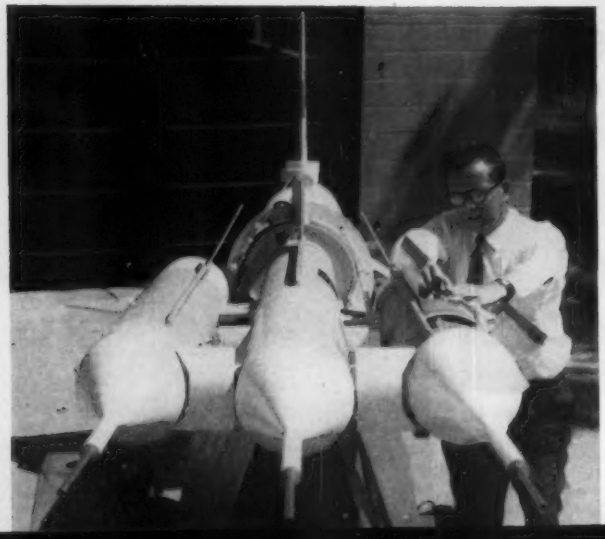
The Bomarc, shown being test-fired below, has a liquid rocket for takeoff. When it gains enough speed, two ramjet engines take over.



Deceiver drone. Although it is only 38 feet long, the Kingfisher supersonic target drone for missile marksmen can make itself look like a huge bomber on search-radar screens, as shown in the artist's conception at far right.

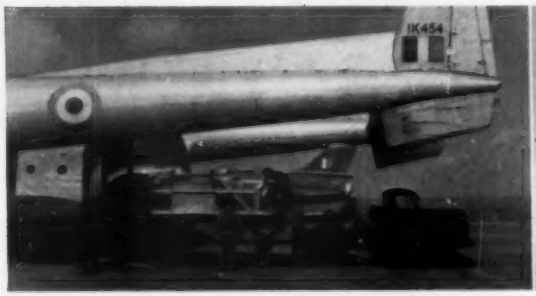
Electronic device that fools the radar is the basketball-shaped object above. Next to it is a firing-error indicator that registers hits or misses and radios the information to the ground. The drone also performs evasive maneuvers.

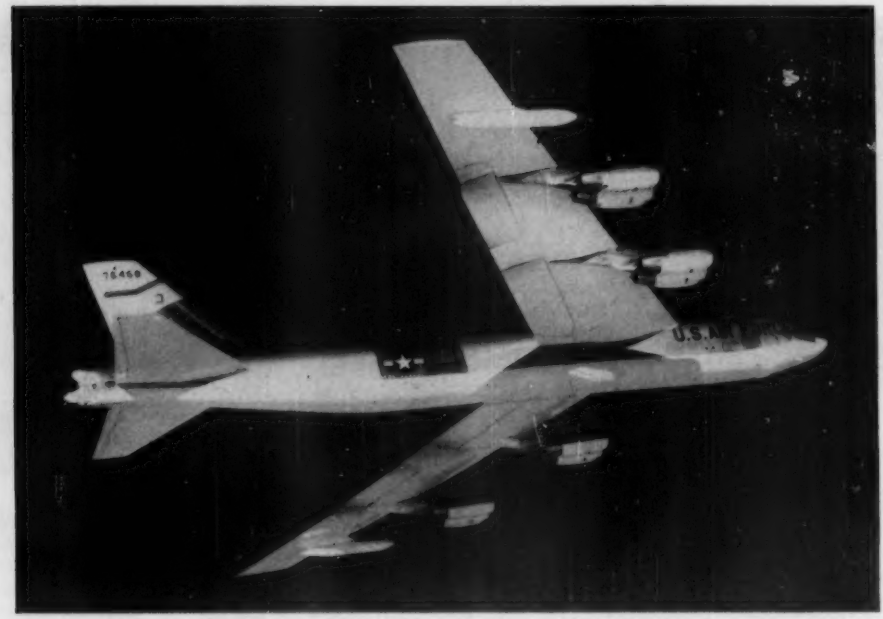
Main body of the rocket-boosted, ramjet-powered Lockheed drone is 20 inches in diameter (photos at right). For recovery at the end of a flight, a pop-out parachute lowers it head first, and the spike nose is buried in the ground.



Triple nose. In each of these three missiles is packed a parachute for Air Force testing at altitudes up to 150,000 feet and at speeds of more than 3,000 m.p.h. A rocket behind the middle missile boosts the cluster to altitude and speed. The units separate. A timing mechanism opens the parachutes, and a rear-facing camera in each missile records performance.

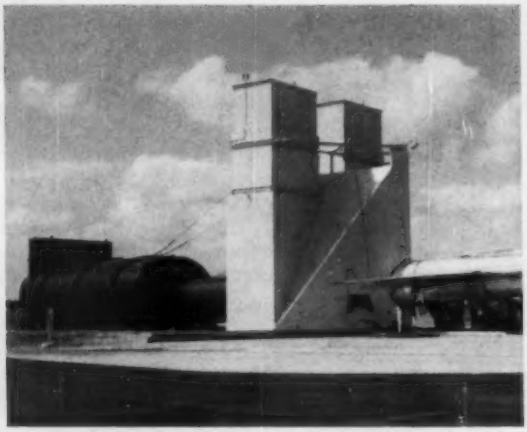
Jet stowaway. With wings removed (left), the little British Gnat fighter plane slips easily into the hold of a Fairchild Packet transport. Destination: Indian Air Force, where the 30-foot-long, almost-supersonic jet is in service. In flight (right) Gnat has a 22-foot wingspan, can operate above 50,000 feet.



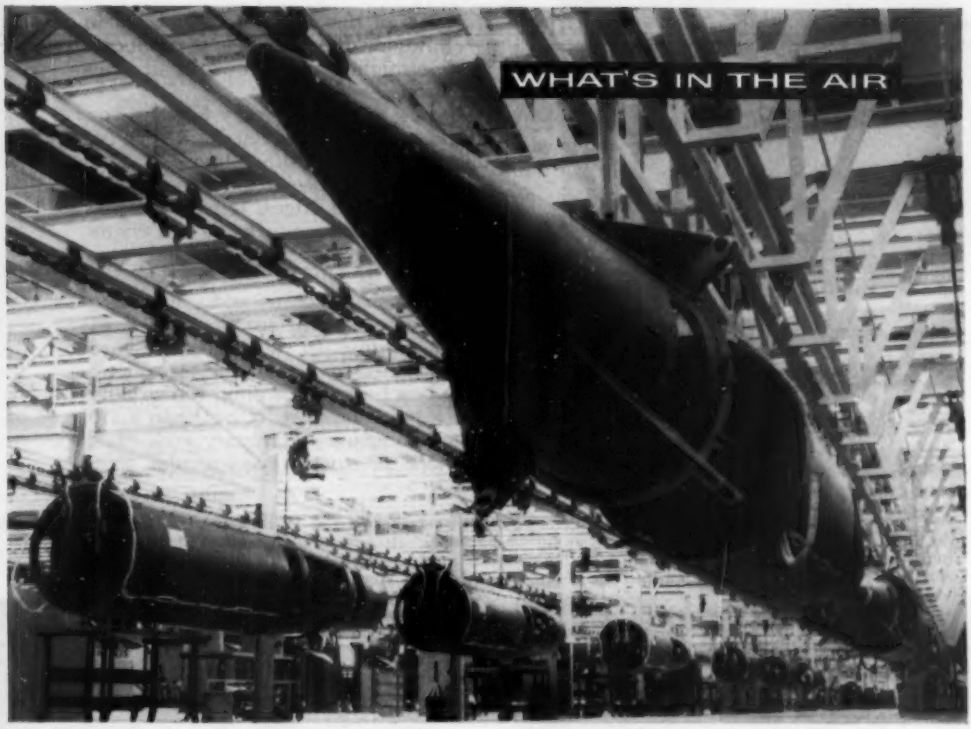


Missile platform. Here, in first flight, is the newest version of Boeing's Stratofortress—the B-52G. Its eight engines—more powerful than in earlier models—and increased fuel capacity enable it to fly 8,000 miles without refueling. Its big punch will be supersonic, nuclear-warhead Hound Dog missiles with a range exceeding 1,000 miles after air launch.

3-D radar. Protected by plastic balloon, new Army radar detects targets in three dimensions—height, bearing, distance—by frequency scanning, "moving" the beam electronically, instead of antenna movement. Hughes Aircraft made it.

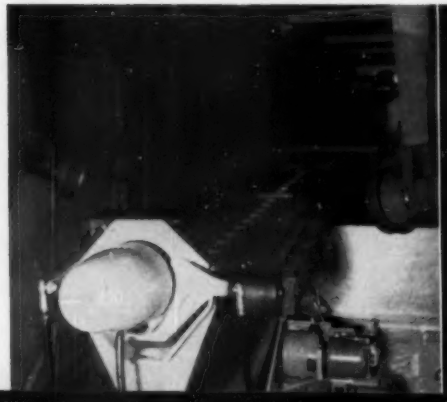


Thunderchief muffled. With this two-story silencer, it's quieter at Republic Aviation, Farmingdale, N. Y. When an F-105 fighter-bomber is backed into it, the roar of its 15,000-pound-thrust jet engine is tamed to talk-level tolerance.



Nike-Hercules in production. The Army's local-defense missile that can carry a nuclear warhead is now an assembly-line item. The big one above, at Douglas Aircraft Co.'s Charlotte, N. C., division, is complete except for the warhead that will go into the gap between the nose and the body, and booster rockets. The Nike-Hercules is 41 feet long, has a speed three times that of sound and a range of about 100 miles.

TV trainer. Approach lights and markings of an airport runway are simulated on a moving belt by dots of fluorescent paint (below, left) and photographed under ultraviolet light by a TV camera. The moving scene is reproduced on a screen so a pilot sees it as he would through his windshield. The DALTO system was developed by Doman Helicopters.



Home and Shop

Jobs You Can Do with a Jointer

By R. J. De Cristoforo

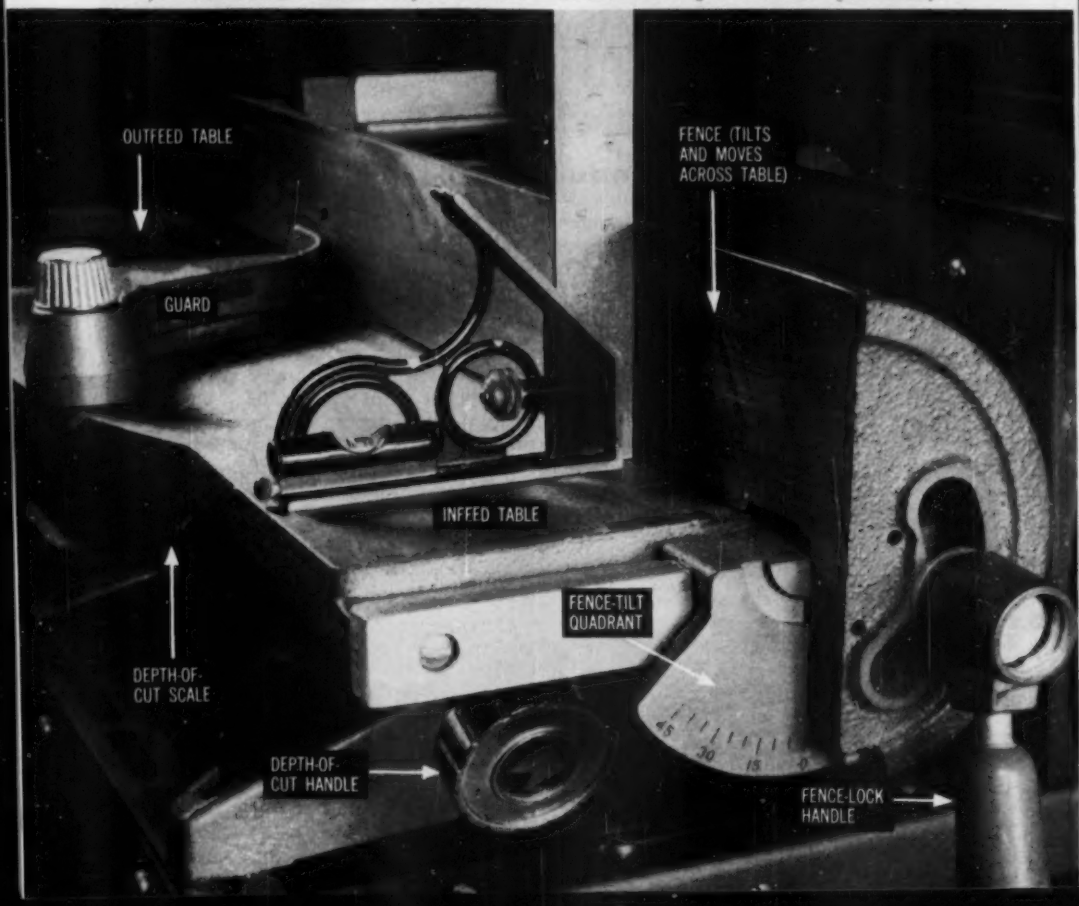
ONE of the first rules you learn in woodworking class is to produce a straight edge from which all other dimensions are derived.

That's a jointer's primary job. But you can do a suprisingly large number of other useful things with it, too.

Although its specialty is planing, or *jointing*, finished edges, it has no equal for running off smooth bevels and chamfers. It will cut rabbets and form tongues and tenons. It joints tapers quickly and accurately, shapes coves, and can be used to some extent to surface stock.

Edge jointing. In cabinetmakers'shops you'll usually find a jointer teamed up with a bench saw. Pros almost invariably make a pass across it, rather than a rip cut, to establish a preliminary work edge. Or, where the stock is too irregular, they

PARTS OF A JOINTER. Before using this tool for the first time, check the accuracy of the angle indicator. If a square gives a reading other than zero, loosen the setscrews and readjust the fence bar in relation to the table. On some jointers you move an adjustable pointer. Either way, once zero is established, all other readings will be accurate. Repeat this check periodically.



start with an outside rip cut, then use the jointer to dress it down.

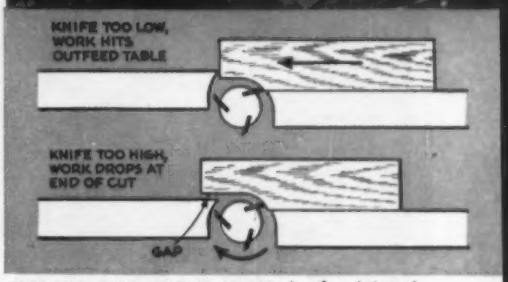
Using a combination of saw and jointer this way, you can cut and smooth boards to exact width throughout their lengths. Laid edge to edge, the pieces will mate perfectly—a must if you want to glue a number of them together to form a large, warp-free panel of solid stock. A word of warning, though: Always shove the wood into the blades with the grain inclined up and away from them. Otherwise they may dig in.

Bevels and chamfers. By tilting the adjustable fence of a jointer and sliding one face of the work along it, you can bevel and chamfer edges at any angle from 45 to 90 degrees. All bevels and most chamfers require a number of passes across the blades, as no more than a ¼″ of stock thickness should ever be removed at one time.

To make sure a bevel or chamfer doesn't waver, clamp a guide block parallel to the fence with just enough space between the two to form a track for the piece being shaped. Whenever possible, incline the fence toward the blades. This will help hold the stock down. If the fence must be tilted at an open angle, cut a matching bevel on the facing guide block edge to act as a hold-down.

Rabbets and tongues. These are naturals for a jointer. There's none of the fuss and bother of setting up a table saw twice, with the chance of mismated cuts. Instead you simply place the fence at 90 degrees and move it across the broad blades until just the width of the desired cut is exposed. One pass will give you a rabbet or a side-forming cut for a tongue as deep as ¼″. By lowering the forward, or infeed, table again, you can double this depth.

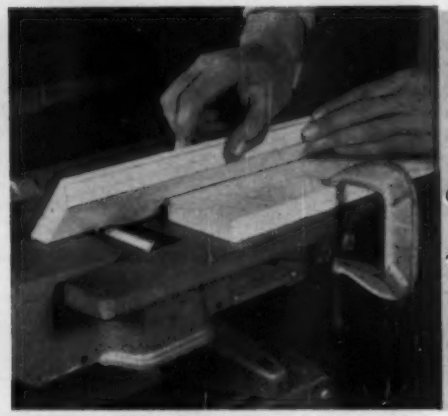
Crossgrain work. A jointer will do end planing and make lap cuts well, but only if you use it right. First, be sure the blades are sharp—they should be for any job, but it's most important here to prevent tearing. Next, waste stock should be removed with a series of shallow cuts —not one deep one. Finally, to avoid splintering edges at the ends of passes, work in from both sides when jointing. Start with a short cut (only an inch or so across the blades). Then flip the stock and make a second, full-width pass. Where you can't use this method (for

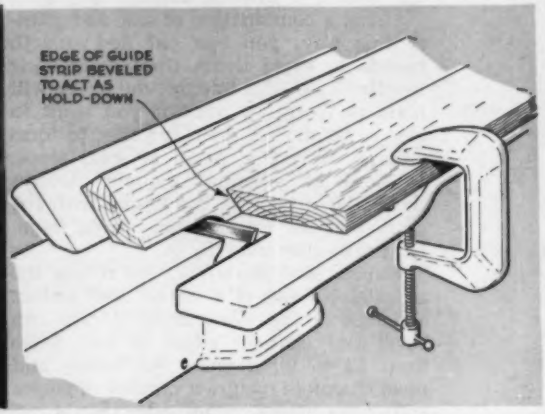


PLANING TRUE WORK EDGES is the jointer's primary job. Arrow in photo above shows how height of infeed table relative to blades determines the depth of cut. Outfeed table offers support as the jointed edge travels over it.

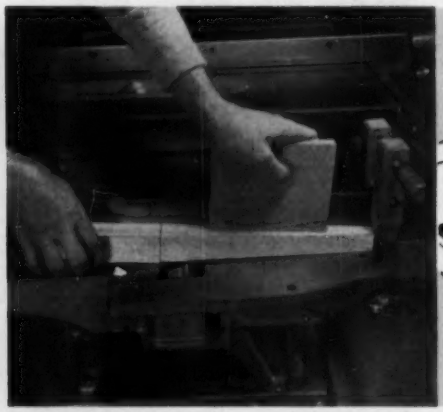
Quick-Cure Clinic for a Jointer

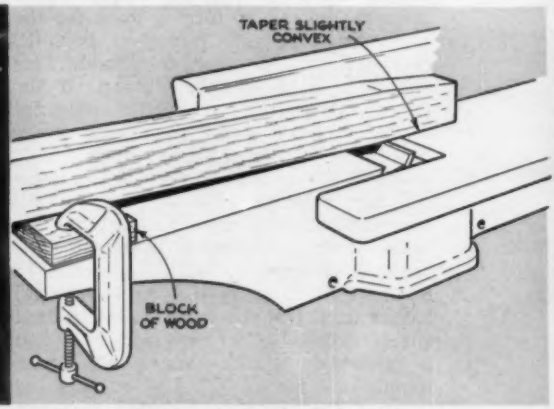
TROUBLE	DIAGNOSIS	REMEDY
"RIPPLED" OR UNEVEN CUT	incorrect cutter speed	run at approximately 3,500 r.p.m.
	feeding work too fast	slow feed always produces smoother cuts
	incorrect blade setting	reset so all blades are cutting
	vibration	keep steady pressure on work throughout pass
WORK GOUGED AT END OF PASS	blades too high	reset flush with plane of outfeed table
WORK HITS FORWARD EDGE OF OUTFEED TABLE	blades too low	reset flush with plane of outfeed table
CUT IS CHIPPED AND/OR SPLINTERED	working against grain	turn work end for end; make second pass
WORK EDGE NOT SQUARE	fence out of alignment	reset 90 degrees to table
	work not held correctly	hold work firmly against fence
RIDGES ALONG LENGTH OF CUT	blades nicked	if honing doesn't correct, resharpen by grinding





BEVELING AND CHAMFERING: Recommended way is with the fence at a closed angle, and a guide strip substituted for the regular jointer guard. Where this isn't possible, and the work must be done with the fence tilted at an open angle, use a beveled guide strip as a partial hold-down, as shown in the drawing. When beveling or chamfering the ends of long stock, attach a wide board to the fence, using the screw holes provided for that purpose.



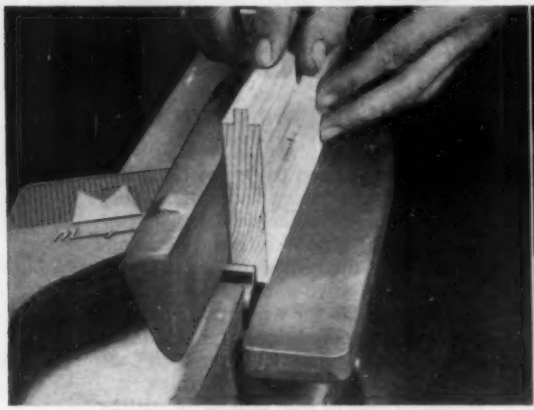


TAPER JOINTING: Angling work between the two tables and drawing it back across the blades forms tapers like the one shown above. Use several shallow passes rather than a single, heavy cut. For short tapers on long stock, clamp a block at the far end of the outfeed table and rest the work on it. To make very long taper cuts, extend the infeed table by clamping a strip of ¼" plywood above it. Lower the table to compensate for the extra thickness.

tenons and lap cuts), protect the trailing edge of the work by backing it up with a piece of scrap.

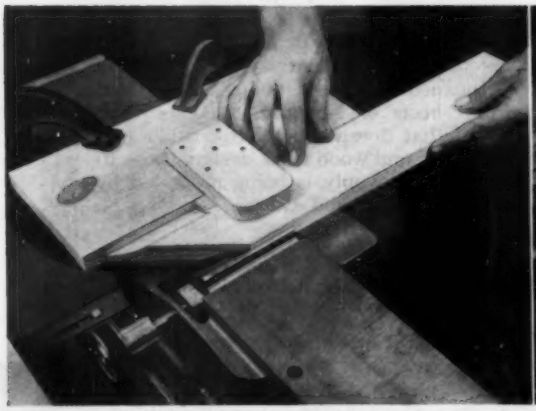
Taper forming. This is one of the most useful jointer operations. Unlike table-saw tapering, you don't need a special jig—only a stop clamped near the forward end of the fence to control the length of cuts. Lower the infeed table for the desired taper. Then, bracing what will be the slimmed-down end of the stock against the stop, lower the material slowly to rest on the forward edge of the outfeed table. Using a block of wood as a hold-down, pull it back across the blades. Where more than a ¼" taper is required, set the table no lower than that and use two or more passes.

Forming coves. Because a jointer's blades cut in a circle, they can be used



TONGUE AND RABBET FORMING: Width of cut is established by the blade section projecting beyond the fence. Because the outboard fence end is not supported, too much side pressure may shift it. Use the fence only as a guide.

SHAPING ROUND TENONS ON DOWELS: An L-shaped guide block clamped to the infeed table positions the work. Rotate dowels *against* the cutter's direction. Diameter is controlled by the block location and table height.



RUNNING OFF COVES: Pushing stock *across* the blades produces these with shaper action. A simple jig doubles as a guide and hold-down. Note direction of the grain in relation to that of the cutter. Never gouge into the grain.

SURFACING STOCK: Use two hold-downs, as shown, one with an under-riding lip, to advance the work across the cutter. They should be wide enough to offer good cross-control when handling warped boards that might otherwise rock.

like those of a shaper to cut coves. Tilt the fence out of the way and run the stock *across* the infeed table. Use a strip of wood as a guide, one with a hold-down projection to keep the work pressed firmly against the blades. If you angle the guide slightly, you can run off flat-bottomed coves.

Surfacing. A jointer will plane the faces of boards, but it won't guarantee that opposite sides will be perfectly parallel afterward. When a jointer is used for surfacing, the wide blade areas in contact with the wood exert a strong upward thrust. To keep the work flat and steady, individual cuts should be very shallow. It's also best to use two hold-downs, one ahead of and the other behind the cutter. Feed the stock slowly *across* the blade. END

New Hardware for Bi-Fold Doors

makes it easier for anyone to install and maintain them

IF YOU have a congestion problem due to a wide-swinging door, you can switch to a folding door, using a new hardware kit that assures easy installation and smooth operation. In many cases, you can cut the existing door down the middle and re-install it as a bi-fold.

Hinges are included in the kit, but only for joining the folding panels. The door is actually hung on special nylon pivots—one locked in an aluminum overhead track screwed to the doorway header, the other screwed to the floor or bottom of the jamb, depending on whether or not the door swings over carpeting. The top and bottom pivot sockets can be adjusted and plumbed by turning a single hex-head screw on each while the door hangs in place. A thin wrench is included in the kit for the purpose.

Two hardware kits are made by Stanley: No. 2983, containing surface-mounted fittings which are simply screwed to the inside of closet doors where they can't be seen; and No. 2989, a dressier version with fittings designed to be mortised into the edges of passageway doors where they are invisible from either side.

Prices on the kits, of either type, range from $4.10 for the hardware and track to install a single two-panel door in a 2′ opening, to $9.20 for everything needed to swing a four-panel double door in a 6′ doorway. Four other widths—2′ 6″, 3′, 4′ and 5′—fit most finished openings.

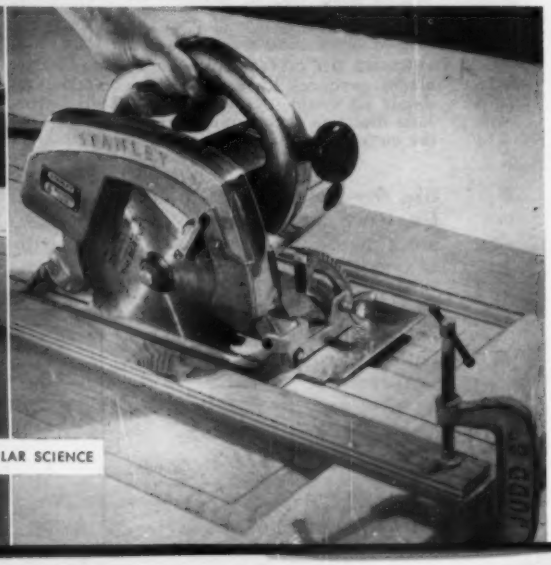
You can make bi-fold panels by cutting a single large door in half, provided it has a solid center. Hollow-core doors can be paired for wide openings.

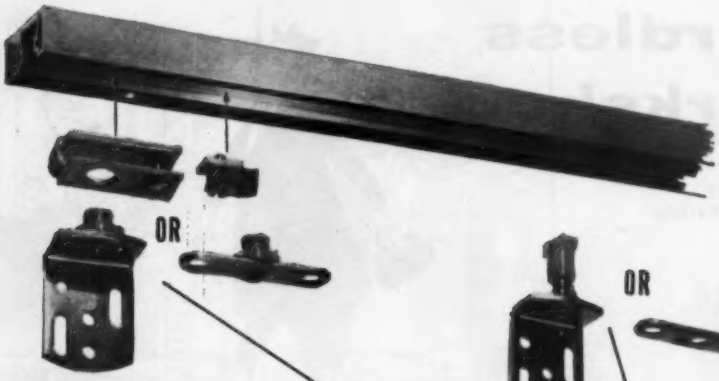
Louvered doors also make attractive bi-folds. They come in many widths, starting as narrow as 7½″, making it easy to group two or four equal widths together to fill a doorway.

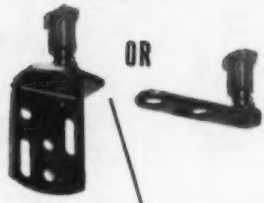
Inexpensive closet doors can be cut from sheets of Novoply, a composition board that doesn't warp. Special bi-fold hardware and wood track designed specifically for Novoply is being marketed by the U. S. Plywood Corp.

BI-FOLD DOORS OPEN WIDE for a full view of closet or cupboard contents, yet they save swing space in small rooms, tight corners and halls. The doors shown here were made by cutting two Ponderosa-pine paneled doors in half.

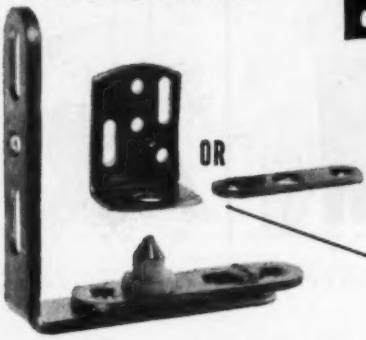
HOW TO CUT A DOOR: Mark the cutting line and clamp a wood strip to the door to guide the saw accurately. A colonial-style door with a solid center stile is easiest to cut. Hollow-core doors must be filled in with wood strips if halved.

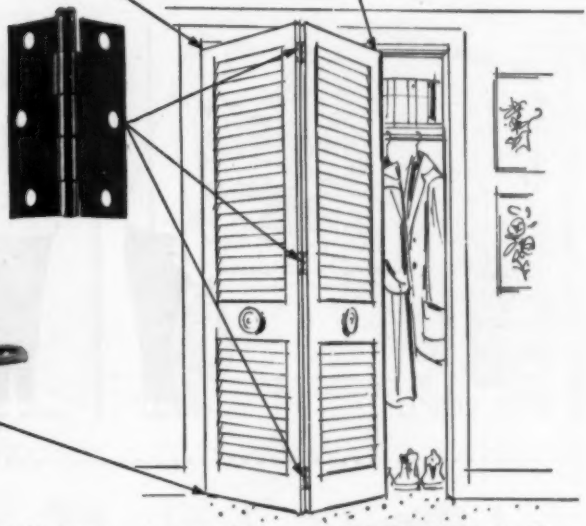




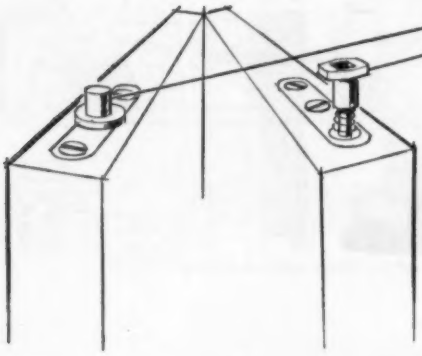


HARDWARE NEEDED to hang folding doors from ¾" to 1⅜" thick is included in one kit. Track and fittings in concealed and surface-mounted kits are identical except for the bottom door socket (below), top door pivot (above) and suspended guide (above, right). Surface-mounted fittings are screwed to door edges; concealed fittings mortised in.



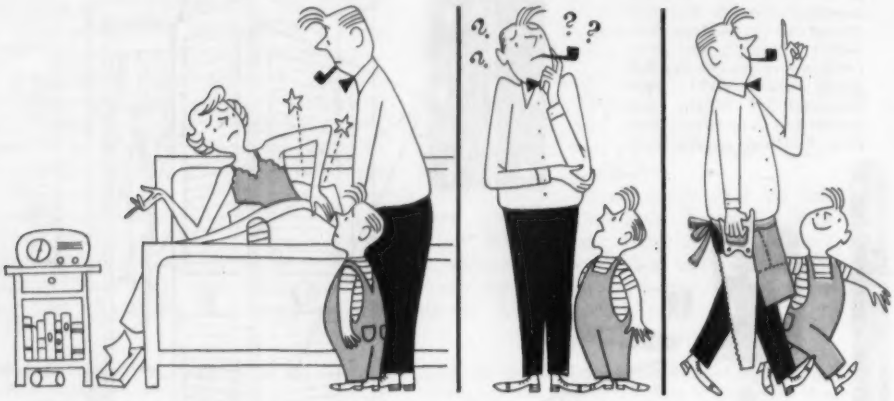


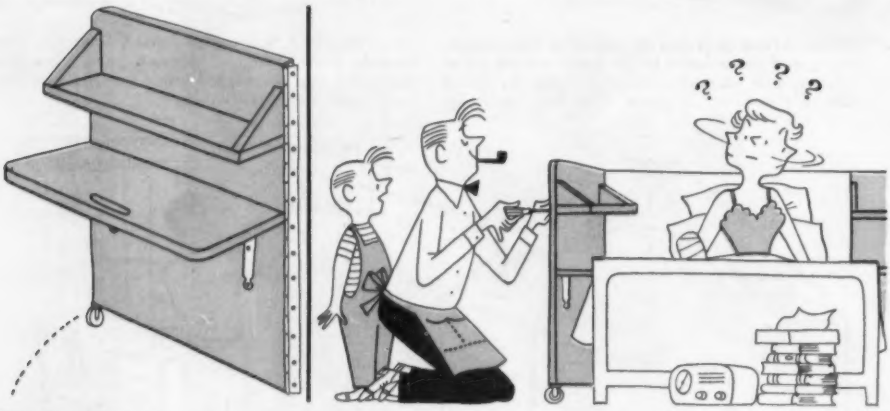
INSTALLATION provides for plenty of adjustment. Elongated screw holes in the bottom jamb pivot (shown just above) permit shifting the pivot after it's screwed in place. The door, with fittings attached, is installed folded (below). The bottom edge is set on the jamb pivot; then the top pivot and suspended guide are slid into the track and both pivots locked.

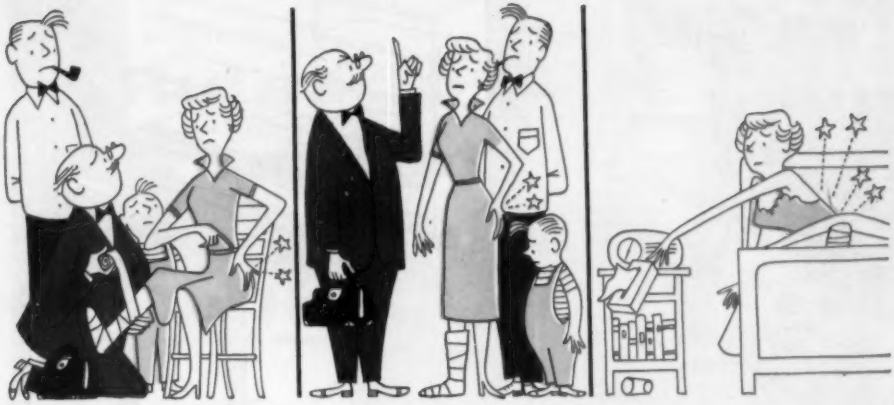


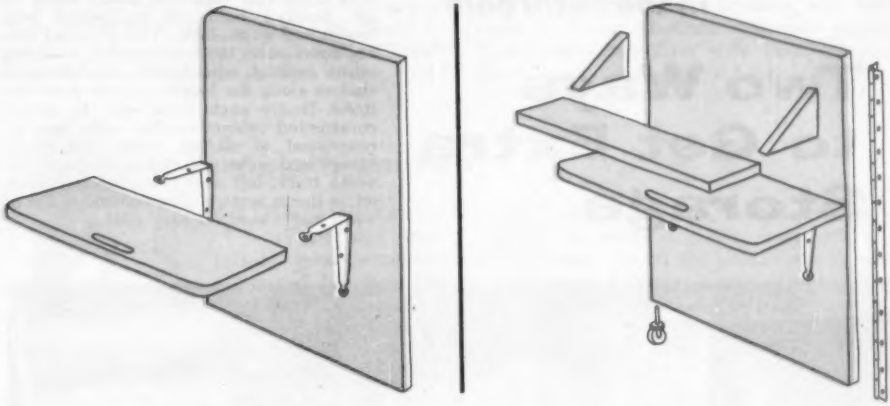
Wordless Workshop

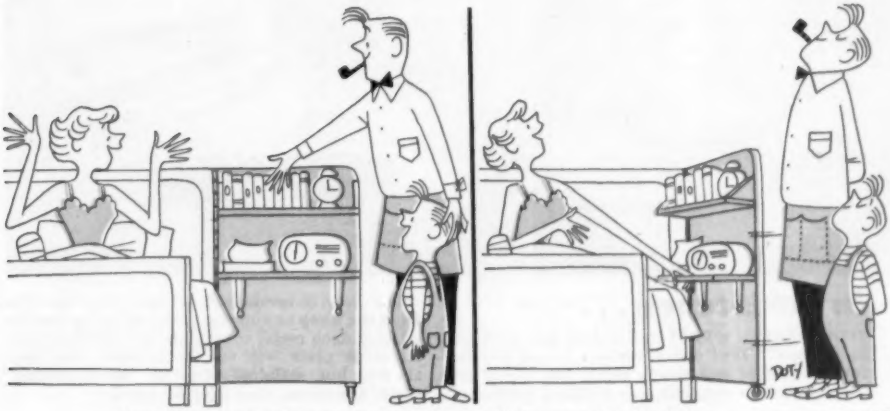
By Roy Doty
and Harry Walton



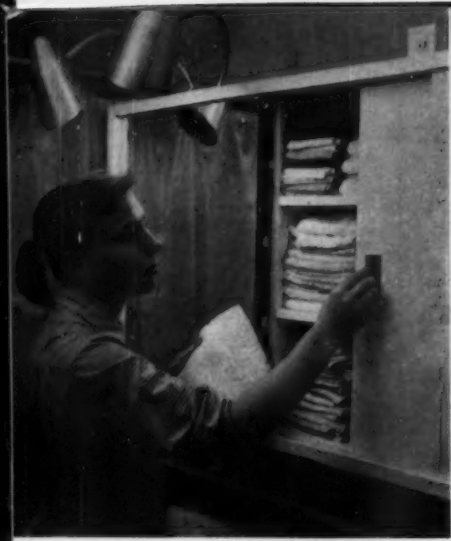


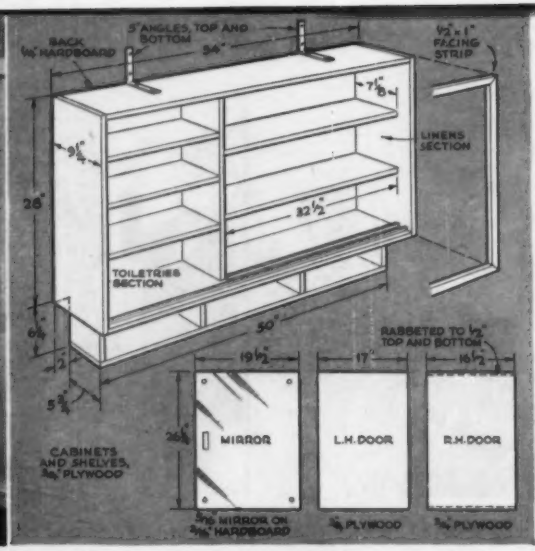






Next Month: A step stool to help small fry reach tall sinks

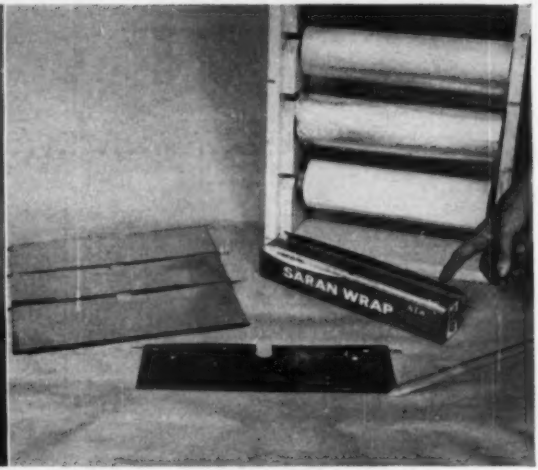




In the bathroom . . .

Two Ways to Get Extra Storage

THIS KING-SIZE MEDICINE CHEST holds all the family's bathroom equipment plus towels and wash cloths. Two plywood sliding doors cover the linen section; a sliding mirror conceals toilet articles. Shallow open shelves along the bottom are for everyday items. Heavy angle irons hold the simply constructed cabinet on the wall. Note arrangement of sliding doors and track: Mirror and right door move in outer full-width track, left door rides in inner track set in linens section. Tracks were made of wood and waxed for easy sliding.



In the kitchen . . .

STORE KITCHEN WRAPS in a tear-off box set flush in the wall. This one dispenses paper towels, foil, wax paper and plastic wrap. The box is not seen, so only a simple frame notched for dowel roller bars is needed. A serrated tearing strip from the wrap carton was soldered to the bottom edge of each metal cover flap. An old chromium ferrotype plate was cut up to make the flaps shown, but stainless steel or "do-it-yourself" sheet aluminum can also be used.

3 Rules to Keep from Getting Stuck on a Building Lot

By John L. Springer

EVERY year hundreds of thousands of Americans buy building lots. Many go on to put up homes and are well satisfied. A few, foresighted or just lucky, hold them for a price rise and make money. But a large percentage get stuck.

Bankers, real-estate brokers and officials of Better Business Bureaus advise that you're gambling with your savings unless you observe three basic rules:

1 Never buy sight-unseen

WHEN times get prosperous, fast-talking land promoters come out in force. For 10 dollars down and 10 a month, they tell you, you can pick a choice parcel by a lake or ocean where you can put up a low-price cottage and live it up.

Some land promoters deliver what they promise. But the files of Better Business Bureaus bulge with case histories of innocents duped by what the Detroit bureau calls "the mist of distance and the magic of words." An Ohio couple agreed to pay $1,500 for a lot "overlooking a lake." A year later they finally inspected their property—a marsh beside a mosquito-infested pond. A Michigan family paid $2,700 for a lot adjoining a big lake, learned later that it also adjoined an all-night gas station and a noisy, heavily traveled highway.

Brokers firmly advise that you investigate a building lot as thoroughly as a house, and the National Better Business Bureau urges that you get a satisfactory answer to these questions:

- Can you build on the lot? On some you'll need expensive, reinforced foundations to keep a house from settling. Others may be on the side of a cliff, and you'd need a house especially designed for the site. Some lots are so small or irregular that you couldn't build without violating zoning laws. Lot buyers in one development couldn't get FHA mortgages because septic tanks wouldn't work satisfactorily on the land.
- Are you reasonably close to shops, schools, churches, and whatever else the land promoter promises? It takes personal investigation to tell whether the shopping center allegedly within walking distance can be reached in 15 minutes—or three hours. One promoter advertised lots near a lake where you could swim, boat and fish. How near was near? In this case, 27 miles. Any claims about location or distance should be checked, either by walking or against your car's odometer.
- Are roads, sidewalks and sewers in and paid for? And are water and electricity available? Some developers will sell you a lot, promising to put in improvements later. If they run short of funds, you'll wind up with an unimproved lot worth little or nothing.

2 Don't buy unless you intend to build soon

SO MUCH can happen to you and the neighborhood that it's impractical to buy land with the idea of building five or 10 years from now. Real-estate brokers give these reasons why you shouldn't:

- A change in public tastes. Your land may be okay for the kind of house you're thinking of today, but will it be suitable a few years from now? Before the war, many people bought lots only 40 feet wide. They were large enough for the square, two-story houses popular then. After the war, sprawling ranch houses became the vogue. Values of the lots dropped to a fraction of their cost.
- A change in your own tastes. Say you now lean toward split-levels, so you buy a sloping lot where that type house would fit perfectly. A few years from now, you may hate the idea of stair-climbing in a split-level. But try to build a ranch house on that sloping lot.
- A change in the neighborhood. Unless you buy in an established community or one with ironclad zoning, you may wind up with a lot that looks okay for a house today but will be hemmed in by stores or factories a few years from now.
- Increases in taxes and commuting costs. Eight years ago, say, some suburban area might have lured you, by its low tax rates and reasonable costs of commuting, into buying a lot. But since then, thousands of homes may well have been built there, requiring expensive new schools. Results: skyrocketing taxes. And train fares have probably gone up, too.
- The developer may go broke. The Baltimore Better Business Bureau points out that land you agree to buy at so much per month may continue to be mortgaged to the seller while you're paying off. If the seller fails to make *his* payments, the mortgage holder may grab the property.
- Lawsuits over the empty lot. It may become what is known legally as an "attractive nuisance" because it is an alluring playground for children. If a youngster injures himself, you may have to pay damages.

3 Don't buy as a speculation

UNLESS you're a great deal sharper than the average, you only come to grief by buying a lot with the hope of selling it a few years from now at a big profit.

"Most people don't figure in all the costs involved when they buy and hold a lot," says Harry P. Bedell of New York's mammoth Bowery Savings Bank. "You've got to pay for a title search and probably legal fees in addition to the cost of the lot itself. If you didn't put your cash into the lot, it would be drawing interest for you every year. So you must add that to the cost.

"An empty lot produces no revenue, but you must pay taxes on it. They may amount to five percent of the cost per year—often even more. In addition, you must pay extra assessments for roads, sewers, and such. And when you sell, you may have to lay out for advertising, sales commission, more legal fees." Bankers told me that often lot owners who hold their property for years, and sell at double what they paid, still lose money because of the hidden costs of holding a lot.

Big-time land developers make profits because they operate on a full-time business basis and can keep costs down. Before they buy property they usually know exactly how they will sell it. They also can get important tax benefits.

What do these rules add up to? Obviously, you must buy your land before you build your house. But the experience of the experts teaches that it's safest to buy your lot only when you are really ready to build and when you know the kind of house you'll put on it. When you wrap up the house and lot in one package, you'll tend to make a more thorough investigation of the neighborhood, zoning laws and other factors. And, as a general rule, you'll come out ahead. END

The Basic Facts on Resilient Flooring

THERE are five benefits that have made resilient floor coverings a popular choice for modern homes:

- They are tough and long-wearing.
- They are easy to care for.
- They are easy to install.
- They are the softest, quietest, most comfortable floors—not counting carpets—that you can have.
- They are low in cost, for the most part, or can be had in low-cost types.

The early belief that only asphalt tile was suitable for basements or slab-floor houses is no longer true. Today, most floor coverings—although not all—can be used on any floor, anywhere in the house.

There are six basic types of resilient flooring—vinyl sheet and tile, lineoleum sheet and tile, asphalt tile, vinyl-asbestos tile, rubber tile and cork tile. In addition, there are special mixtures such as vinyl-cork and vinyl-rubber tiles. Leather tile, a newcomer, is an expensive but handsome luxury.

Vinyl is the all-around flooring—toughest, glossiest and considered one of the best-looking. It's also fairly high-priced. Asphalt tile is the cheapest. Cork tile is the quietest and softest, and a natural for bedrooms or other areas where noise must be kept to a minimim.

If you want virtually seamless flooring, then the sheet materials are for you. They are made in rolls 6′ wide and up to 90′ in length. Tile size in resilients is commonly 9″ by 9″. Feature strips, edge strips, cove bases and di-

Surprising effects you can get with resilient flooring

WOOD-PLANK EFFECT is made with long, narrow vinyl strips simulating birch, teak, mahogany.

THIS FLOOR LOOKS LIKE A CARPET, is really a vinyl-asbestos sheet with a "broadloom" weave.

VARICOLORED FLAGSTONE looks like individual pieces, is actually a single sheet of linoleum.

agonally cut half-tiles are accessories. Also available are special decorative tiles bearing letters of the alphabet, numerals, and designs such as musical notes and cattle brands.

The resilients are exceptionally long-wearing but may be affected by strong, constant sunlight. Cork, for instance, fades in the sun much as wood does. In other materials, it may pay to remember that neutral tones—grays and tans—are least affected by sunlight. Most vulnerable are the pastel yellows and pinks.

The gauge, or thickness, of resilient flooring varies both by type and by manufacturer. The so-called "standard gauge" is designed for average home use and is usually quite adequate even though it may surprise you to find variations all the way from 1/16″ to ⅛″. "Heavy gauge" types are more expensive and are rarely needed.

Installation for the resilients is about the same for all. You may find tiles easier to handle if you're by yourself; for big sheets, a helper is handy.

On smooth concrete floors, no underlayment is necessary, although you may want one for added underfoot comfort. Concrete floors must be patched and leveled. Underlayment is *always* necessary when covering a wood floor. It may be a layer of felt or one of several special underlayments that are made to go with particular types of floor coverings. If the floor is in bad condition, you may have to start with a rigid underlayment, such as hardboard or plywood.

Denting caused by furniture is more of a nuisance with some types than with others. Cork tile, asphalt tile, and vinyl-asbestos tile are the most vulnerable to denting. Rubber tile, and some of the select vinyls, have the greatest load resistance. Linoleum is moderately strong in resisting dents.

Here's how the six basic types of floor coverings compare:

Asphalt tile was developed as a covering for concrete floors, on or below grade. It is still widely used, especially where costs must be kept to a minimum.

It is highly resistant to alkalis, which are usually present in concrete, but may be harmed by grease and household chemicals. It is fire-resistant. A grease-proof asphalt tile is now available, but it costs more.

Considering its low price, asphalt tile is a good, all-around flooring covering. New color patterns include such effects as confetti, tweed and spatter.

Asphalt tile is the least resilient and noisiest and does not recover well once it is dented. Though durable, it is very brittle and may tend to crack if used on floors other than solid concrete.

Vinyl flooring is one of the richest in appearance, the most versatile, the most expensive. There are many more interesting color patterns in vinyl than in other resilient floorings. Besides the usual marbleized styles, there are many that simulate granite, terrazzo, mosaic, jewel tones and wood hues.

Vinyl is about the nearest thing to a universal flooring that has been developed. It may be used anywhere. It resists oil, grease and chemicals. It has high load resistance. It is quiet, easy on the feet and a snap to keep clean.

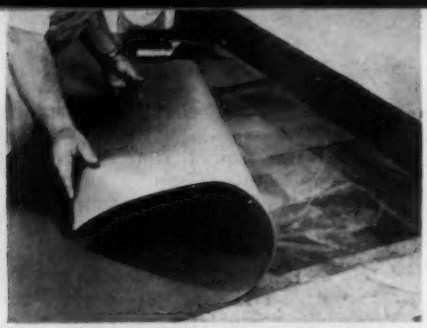
Not all vinyl, however, is the same. These differences are important: Vinyl *tiles* are typically made of solid plastic all the way through and can usually be used anywhere, even on below-grade floors.

Vinyl *sheet*, which comes in large rolls, has a plastic surface bonded to a backing material. The type called alkali-resistant has a special impervious backing that permits its use on below-grade floors. Regular or non-alkali-resistant vinyl *cannot* be used below grade. Special adhesives are also required.

Cork tile is the quietest and most cushiony underfoot of all resilient flooring,

Facts About Resilient Floors

TYPE	SIZES (inches)	PRICE RANGE	WHERE TO INSTALL	GREASE RESISTANCE	EASE OF CARE
ASPHALT TILE Regular	9 by 9 12 by 12 18 by 24	low	any floor above, on or below grade	poor	fair
Greaseproof	usually only 9 by 9	low	any floor above, on or below grade	very good	good
LINOLEUM TILE	9 by 9 6 by 12 4 by 27 4 by 36	low	above-grade floors only	excellent	very good
LINOLEUM SHEET	rolls 6′ wide up to 90′ long	low-med.	above-grade floors only	excellent	very good
VINYL TILE	9 by 9 6 by 6 12 by 12 18 by 18 18 by 36 4 by 36	high	any floor above, on or below grade	excellent	very good
VINYL SHEET Regular	rolls 6′ wide up to 90′ long	low-med.	above-grade floors only	excellent	very good
Alkali-resistant	rolls 6′ wide up to 90′ long	med.	any floor above, on or below grade	excellent	very good
RUBBER TILE	9 by 9 6 by 6 12 by 12 18 by 36 occasionally also in rolls	med.-high	any floor above, on or below grade	good	good
VINYL-ASBESTOS TILE	usually only 9 by 9	low-med.	any floor above, on or below grade	excellent	good
CORK TILE	9 by 9 6 by 6 6 by 12 12 by 12 12 by 24	med.-high	above-grade and dry on-grade floors only	fair	fair



WITH UNDERLAYMENT, resilient flooring can be put down right over existing floors. Type shown above is Armstrong's Cushion-Eze, a special spongy pad made for evening up old floors.

but is less durable. It is a fine, moderate-cost flooring for bedrooms and adds an elegant look to living rooms. But don't put it down in the rumpus room or other areas where there is heavy traffic.

Cork tile is vulnerable to dirt and grease and therefore harder to maintain. It is suitable for on-grade and suspended floors. The tiles come in light, medium and dark brown shades.

A new vinyl-cork combination blends the warm appearance of cork with the toughness of plastic, but is not as springy underfoot as cork alone.

Vinyl-asbestos tile has most, but not quite all, of the advantages of pure vinyl. It is fire-resistant. Available in many unusual color mixtures, it is twice as glossy as asphalt tile because it has a binder of clear plastic.

It makes a good flooring for kitchens, darkrooms and utility rooms because it is not harmed by oil, grease or most chemicals, including dilute acids. It may be installed on concrete floors below grade.

The hard, dense surface of vinyl-asbestos tile makes it long-wearing, easy to keep clean. At the same time, it offers less foot comfort than the other resilients —with the exception of asphalt tile—and is noisier than most.

Rubber tile is, next to cork, the quietest and most comfortable. It also ranks next to vinyl in good looks. As might be expected, it is just behind vinyl in price. It is relatively immune to oil, grease and chemicals.

Like cork, rubber tile requires somewhat more care than other floorings. An occasional buffing with fine steel wool is necessary to heighten its good looks. But unlike cork, it may be used on all kinds of floors, including those below grade. It also has the second highest gloss rating of the resilients. The first? Vinyl.

Linoleum sheet and tile. The old standby, linoleum, remains a favorite for a variety of reasons. It is moderate in price, extremely durable, very easy to keep clean, greaseproof and has good resilient and acoustic qualities.

The linoleums offer many solid colors (more solid colors than any other resilients, which specialize in mixtures), varicolored and embossed patterns, and simulated wood tiles, planks and rectangles.

Like vinyl, linoleum sheet and tile are usually not identical and thus are not available in the same patterns. Sheet linoleum varies widely in price and quality depending on surface thickness, while linoleum tile is usually available only in a fairly thin, low-cost type.

The best linoleum is one in which the colors and pattern run all the way through from front to back, providing a thick, long-wearing surface.

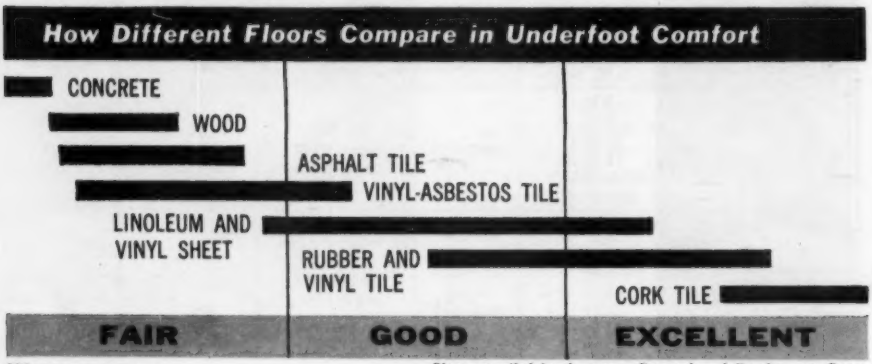
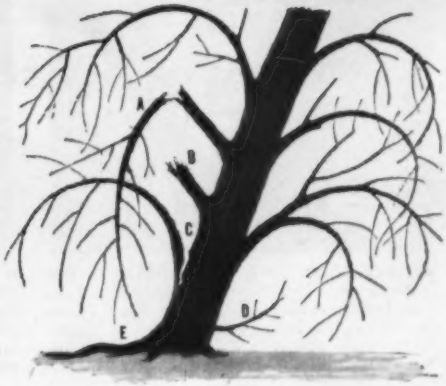


Chart compiled by Armstrong Research and Development Center

Tree Repairs

fix-it file

TIME TO PUT TREES IN SHAPE is late winter—while they are dormant. Farmers have been doing it at that season for hundreds of years. Neglect, storms, sleet and heavy snow can leave: (A) dead, broken or dangling branches; (B) ragged limb stubs; (C) limbs split at crotch; (D) base suckers or sprouts growing out of lower trunk; (E) entire tree blown into a leaning position. Repairs made promptly can save the tree from fungus and decay, and pruning generally stimulates growth by providing more nourishment for the remaining parts. Also, gradual planned pruning from season to season can shape a poorly formed tree into a thing of beauty and an asset to the property.

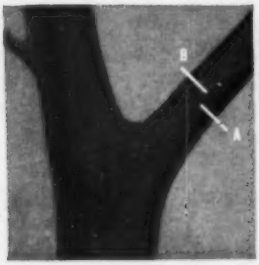


How to prune branches

A POLE PRUNER makes short work of trimming branches too high or too far out to be reached conveniently with a handsaw. Make the cut with the blade resting against the main limb and the support bar hooked over the branch being removed to avoid bruising the bark.

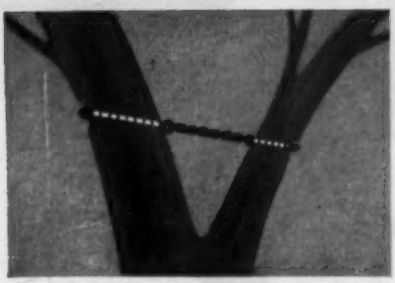
EXTENSION POLES permit shaping the crown of a tree while standing safely on the ground. If a large number of branches must be removed in one area to shape or thin out the foliage, cut back a little at a time over several seasons rather than one to lessen the shock to the tree.

How to cut off limb stubs

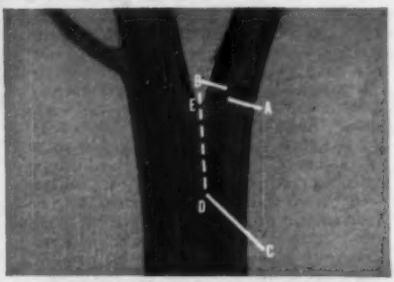


CUT THE UNDERSIDE FIRST if the limb is too heavy to support with one hand. Then make a second cut (B) from above and let the limb drop or have someone lower it with a rope. A handsaw can be used, but a pruning saw cuts faster. Finish the job by sawing through the shoulder of the stub at the trunk (center drawing). Don't try to remove a limb with one cut, as its weight will cause it to snap before the cut is completed, stripping off the trunk bark beneath it as shown in the drawing at right, and leaving a large scar.

Try bracing a split crotch to save it



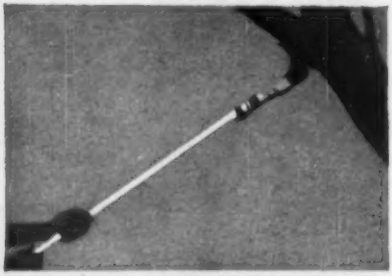
USE EYE BOLTS set in holes drilled in the limbs to pull two spreading parts together. Connect the eyes with wire or light chain and leave the brace permanently in place. Screw eyes can be used in place of bolts to support small or medium-size limbs.



IF A CROTCH MUST BE CUT, use the procedure illustrated above. Make cut A, then B, a foot away from the crotch, and lower the limb to the ground. Then cut in from C to D, and vertically from E to D. Clean up the cut with a sharp chisel or knife.

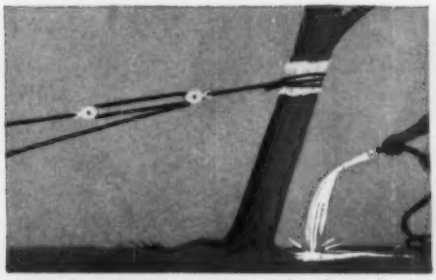
Shape and dress cuts to prevent decay

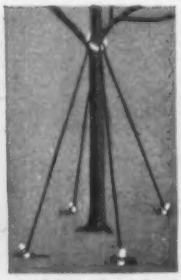
ROUND OR HEART-SHAPED CUTS should be carved to an elliptical or oval shape with a mallet and chisel to help the wound to heal. Cut off protruding lips around the scar to eliminate water pockets and "die-back."

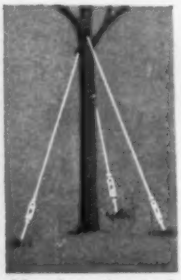


APPLY WOUND DRESSING, with a brush tied to a pole if necessary, to protect cuts until they heal. An asphalt-base paint containing an antiseptic capable of killing parasites and fungus can be bought at a nursery.

How to plumb and guy the trunk







WIND IS ROUGH ON TREES, and soft, moisture-soaked earth loses its grip. A tree blown to one side can be righted by water-soaking the earth around its roots and straightening it with block and tackle. Guys should then be installed to hold it erect. A loop of wire covered by a length of rubber hose (center) is okay for small trees, but to prevent chafing of the bark, use screw eyes driven into the trunk (sounds cruel, but it isn't). Run wires through turnbuckles to the stakes to permit adjustment as the tree grows.

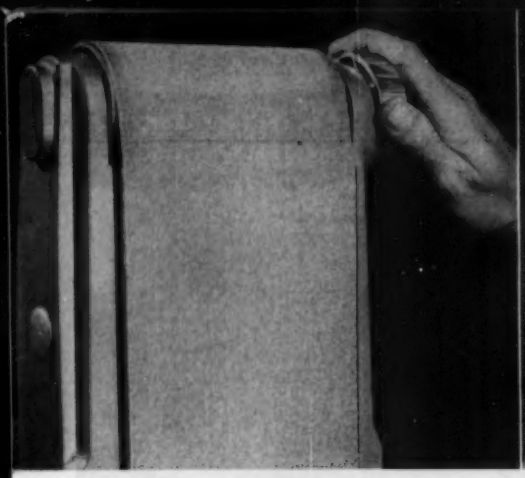
know-how file

Tips for Better and Easier Sanding

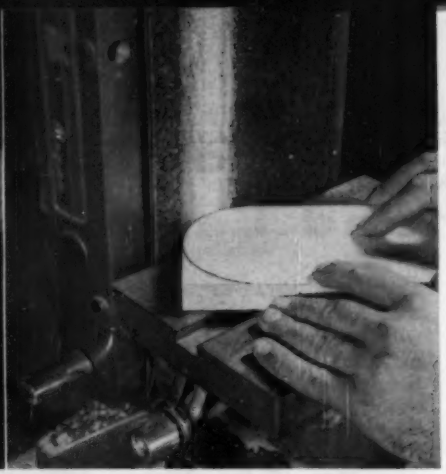
Scrubbing abrasive belts that have become clogged with gum and wood dust may double their useful lives. Use sudsy, lukewarm water and rub vigorously with a stiff brush to work waste out of the valleys. Then mop off the excess moisture and place the belt back on the machine to dry. Or stretch the belt lightly between two sections of pipe or clothes-hanger poles correctly spaced in holes drilled in a board. Readjust machine tension for shrinkage.

Periodic "dry cleaning" with a stiff brush slows the accumulation of stubborn waste on a belt or sanding disk. Work the brush in all directions to reexpose the sharp cutting grains. If you value the brush don't do this while the abrasive is under power; you'll wear its bristles down to stubble in record time. Instead, rotate the disk or drum slowly by hand while scrubbing out the wood dust and gum.

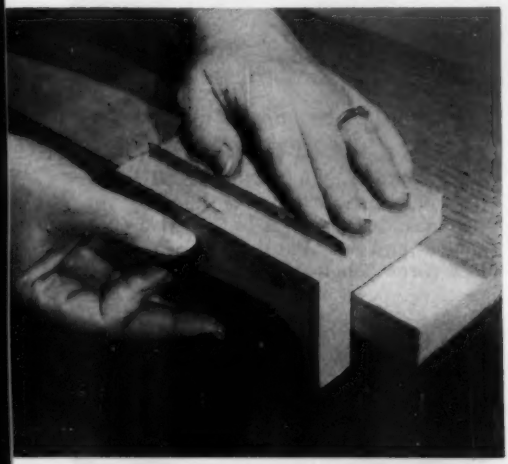
Remove build-ups of pitch that cause slick spots with a brush soaked in turpentine. Use a circular motion; then stroke in one direction to throw off excess solvent and dirt. Pat dry with a cloth before turps penetrates the backing.



Always crown a new belt. To prevent "walking," the drums of belt sanders are slightly thicker at their centers. When you mount a new belt, apply excessive tension and let the machine run for 20 seconds or so, to stretch the cloth to a conforming bow. Then slack off slightly on the tensioning knob.

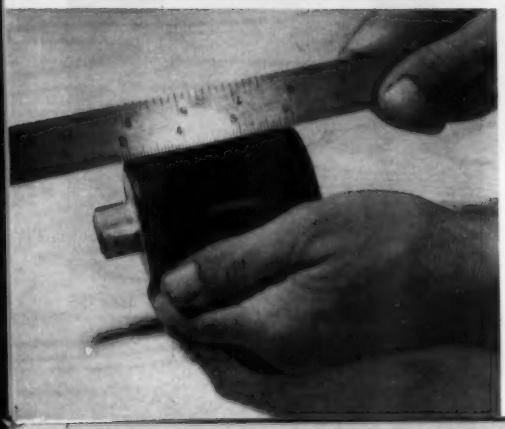


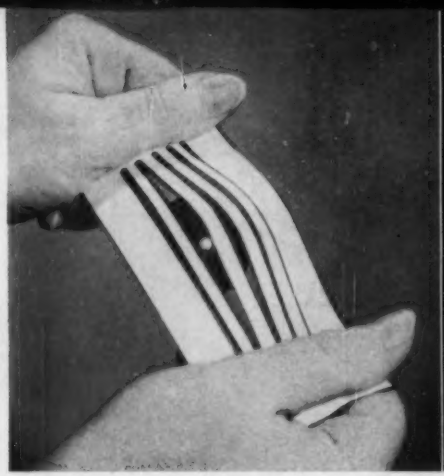
Avoid uneven belt wear. Move the stock around so you use the whole cutting surface. Too much wear in one area, as above, will cause distortion and the belt won't run true. Avoid hard pressure; the belt, not you, should do the work. Abrasives last longer if used to finish, *not* shape, parts.



Keeping edges square is easy, with an L-shaped sanding block made from two pieces of ¾″ scrap. Screw them together with a strip of sandpaper sandwiched between them. The unsurfaced, or "safe," edge of the block slides smoothly along the face of the work, holding the wood-backed abrasive firmly perpendicular.

Drum-sander check. Sanding sleeves are snugged to these by drawing up on two core pieces to expand a rubber drum. In time this drum may become bowed at the center, or run eccentrically, leading to poor work and fast abrasive wear. Tighten the core bolt and lay a straight edge on the surface. If it isn't flat or slightly concave, run the drum under power and use sandpaper wrapped around a block to re-form a true cylinder. Apply very light pressure to prevent roughing or burning. When distortion is excessive, try wrapping tape around those parts of the core that need to be raised.



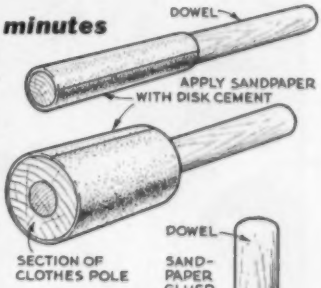


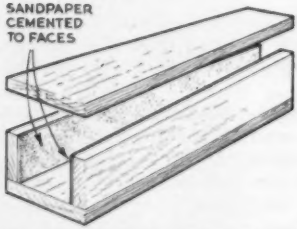
Sanding rounded surfaces need not be an awkward chore. Cut parallel slits from nearly end to end of a sanding sheet and the resulting flexible ribbon will conform to the work as you draw the abrasive forward and backward across it. The narrower the ribbons, the smaller the curvatures they'll follow.

Working right up to inside corners is no problem when you bevel one edge of a sanding block and staple sandpaper snugly around it. A word of caution: If the direction of the grain makes it necessary to sand *along* an inside corner, avoid side pressure or you'll score the abutting surface.

Four sanding attachments you can make in minutes

Drum sander. A piece of abrasive paper cemented around a dowel makes a miniature drum sander that will smooth inside edges of fretwork in jigtime. For larger edge-sanding jobs, use a short section of clothes pole, drilled through its center to take a projecting dowel pin that can be chucked to a drill press or flexible shaft. True the drum section by running it under power while you hold a block-backed strip of sandpaper lightly against it.

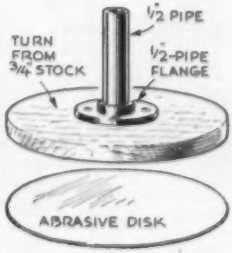


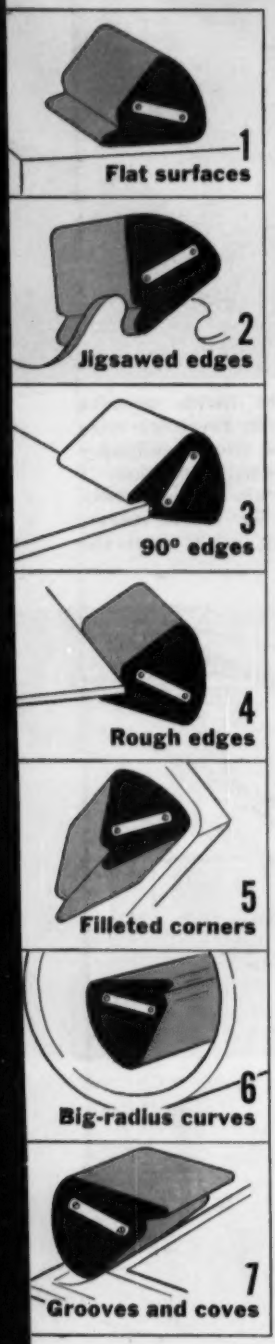


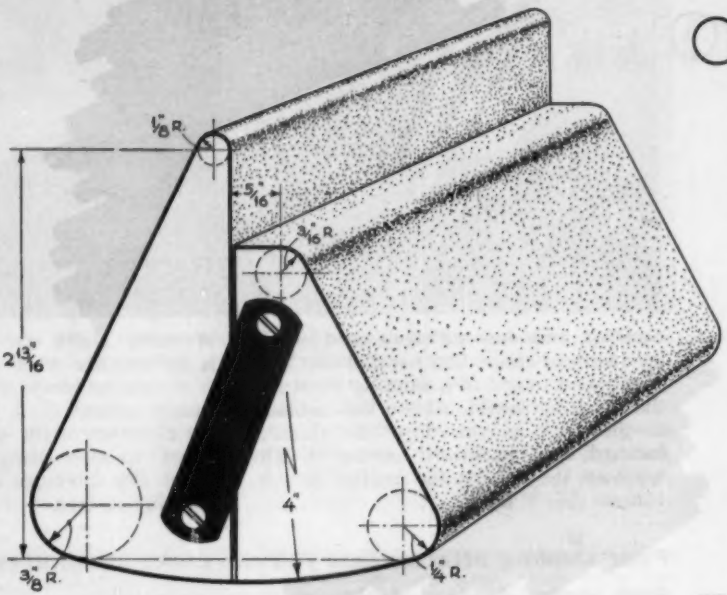
Flexible sander. Cement two strips of sandpaper back to back and insert them in a slot sawed in one end of a dowel. Whipping action of the projecting "paddles" handles convex, concave and compound curved surfaces other sanders can't follow.

Dowel-tapering jig. Sandpaper strips attached to the angled sides of a V-shaped trough do a uniform job of tapering dowels for ship-model masts and locking pegs. Chuck the dowel stock to a drill-press spindle or a flexible shaft and work it into the tapering jig very slowly.

Sanding disk. A section of pipe nipple threaded into a floor flange gives you a perpendicular stem for a sanding disk cut from ¾" wood stock. Used with a drill press and depth stop, this easy-to-make sander is first-rate for jobs such as surfacing small boards to uniform thickness.







Seven-Way Sanding Wedge

HERE'S a novel sanding wedge that will handle flat, convex and concave surfacing, as well as every type of edge sanding. It takes 3″-wide strips cut from standard 9″-by-11″ abrasive sheets.

Cut the two block parts from hardwood, taking care to make their flat planes absolutely level, and each curved section uniform in radius throughout. A bandsaw will do this job the easy way, but with a bit of patience you can shape the members with a handsaw, wood rasp and sandpaper.

To prevent warping, apply three coats of shellac, sanding each lightly with fine-grit abrasive.

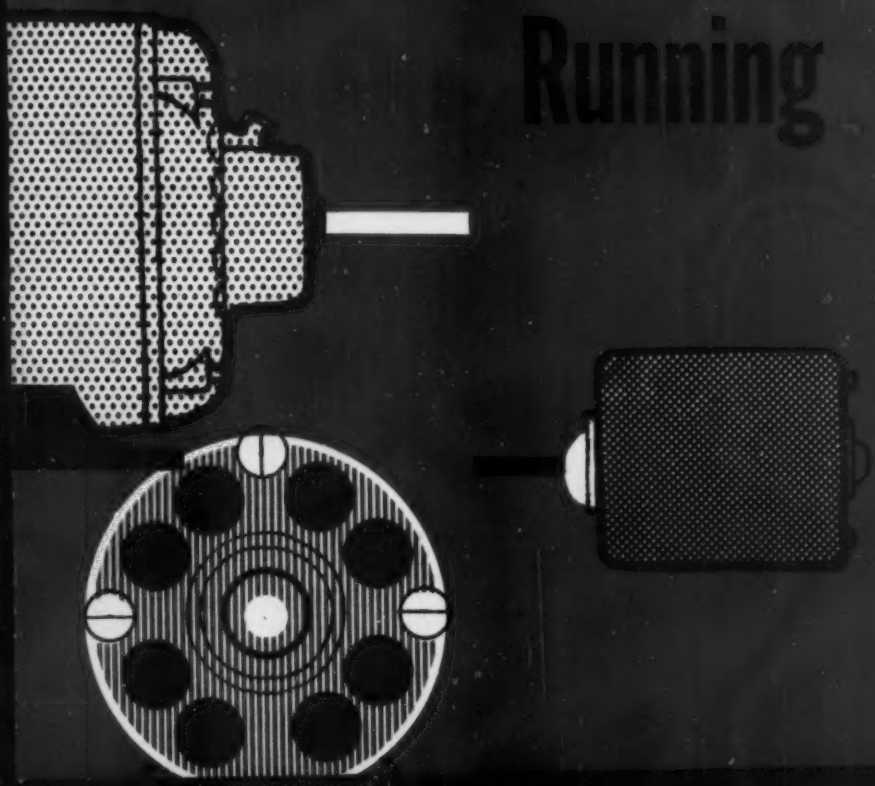
Connect the blocks with metal straps and roundheaded wood screws. Be sure to place the screw holes in exactly mated positions on the two sides of the blocks.

In all operations except Number 3, wrap the sandpaper strips around both blocks and snug up the ends in the slot between them. For Number 3, you want a safe edge to slide along the surface of the stock and act as a guide for perpendicular edge sanding. Here you wrap the sandpaper around the lower block only, and again insert its ends in the slot.

POPULAR SCIENCE REFERENCE LIBRARY NO. 13

Home Owner's Trouble-Shooting Guide to

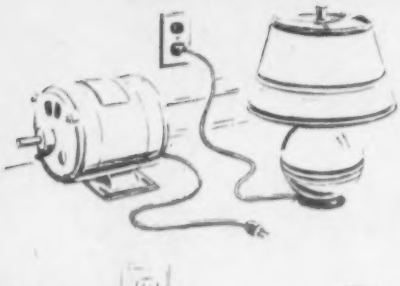
Keeping Electric Motors Running

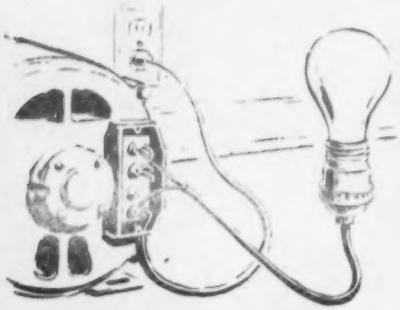


YOU don't have to be an expert electrician to trouble-shoot the electric motors about your house. Once you learn the language of motors, and then follow through with an orderly check, you can spot the trouble and, nine times out of 10, correct it with simple tools and materials that are no farther away than your workbench.

This booklet will tell you the first things to look for if a motor runs hot, loses power, or plays dead. It will give you tips for making simple repairs. Most important, it can save you the expense and inconvenience of major overhauls. The information applies to all house motors, from the midgets in the razors and cake mixers to husky ones in oil burners, major appliances, and shop tools.

Symptom: Motor won't start, no sound





1. No juice at the plug? This seems obvious but, like being out of gas in a car, is the commonest cause of trouble. Pull the motor cord out of its receptacle and plug in a lamp there. If it doesn't light, check your fuse box.

2. No juice at the motor? Often the difficulty is that current is not reaching the motor itself. To find out, make a simple test lamp—a light bulb in a socket with a section of lamp cord attached. Separate the two wires at the free end of the cord to give you a pair of convenient probes. Bare just enough wire at their tips to make contacts.

If there's a switch on the motor circuit, turn it on. Now touch the motor connections or *terminals* (one probe tip on each). If the bulb doesn't light, go back to the switch and check it out. If the trouble is a defective

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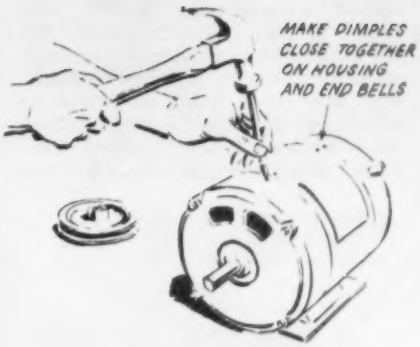
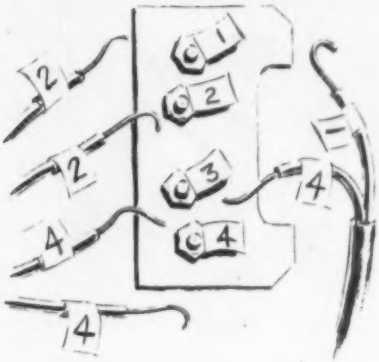
toggle switch, it's usually safer and simpler to replace it. If no juice gets through to the switch, go back and check the cord plug connections. When the trouble isn't there, replace the cord. If the bulb lights at the motor terminals, it's time for internal testing.

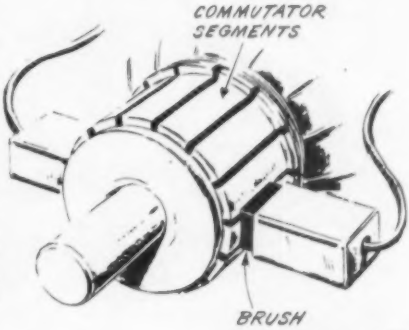
Go slow when you remove the end plates or *bells* of a motor that has a housing. First, remove any shaft fittings (pulleys, collars or sleeves). Then mark the body of the housing and the bells by making punch marks close together. This will help you reassemble them in the same position.

Disconnect the insulated terminal plate, if there's one attached to a bell, and push it inside the housing. Index the wires and terminals with dabs of matching paint or similarly numbered strips of tape. Again, this insures correct reassembly. Slip off a bell, the one with the terminal box where there is one. If, after removing the bolts, you find that it's still wedged in the body of the housing, use a small cold chisel and a hammer—not a screwdriver—to work it free. Too much leverage at one point may damage the bearings, so tap gently all around the rim. Note the location of washers when you pull the core, or *rotor*.

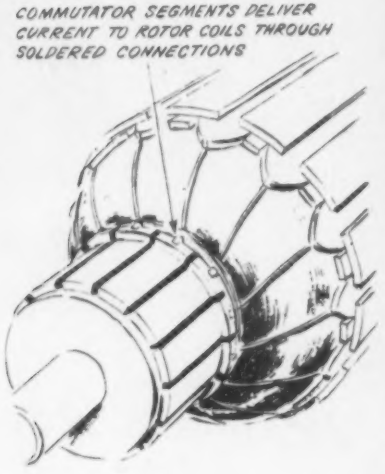


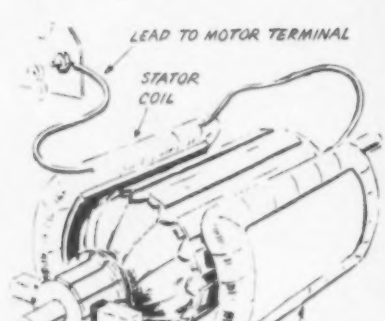


3. Are brushes passing current? Removing the bell may expose a pair of *brushes* and a *commutator*. Check the wires or *pigtails* leading to the brush holders. One of them may have worked loose from its connections or worn bare. A brush may be sticking in its holder, or a weak spring failing to press it against the commutator. Recouple loose brush wires or pigtails. Wrap several layers of tape over any bare spots that have shorted or grounded out. Clean a binding brush with



carbon tetrachloride. Replace both holder springs if one is weak—they are usually set loosely in holder pockets, behind plunger-like brushes. Again, they may bear down on the outer surfaces of lever-like holders to which the brushes are rigidly attached. Take an old spring along as a sample if you shop for a new pair at a motor-supply house. Or specify the motor or appliance model when you order from the manufacturer. Don't use springs of a different type, because too much or too little tension may cause excessive wear or poor contacts. If brushes are badly worn, replace them.





4. Is the commutator passing current? If the brushes are okay, look for a loose connection where the rotor windings are soldered to the commutator segments. If the motor has stopped with one of its brushes contacting such a segment, it will refuse to start again. In other positions it will flip over, but with poor power and excessive sparking.

If you find a loose connection and are handy with a soldering iron, resolder the wire in the slot or to the stud at the rotor end of the corresponding commutator segment. Take care not to touch the coils with the hot iron. Then press any slack against the body of the coil and brush on enough shellac to hold it in place. Don't run the motor until the shellac has dried.

If you don't want to tackle the soldering yourself, take the rotor to a motor-repair shop.

5. How about stator connections? Inspect the wires leading to the winding of the motor's outer, stationary magnet, or *stator*. If one of them has come off a terminal post, fasten it back in place. When a wire is broken, bare the ends, twist them together and solder the splice. Then wrap with tape. If an exposed section of wire is producing a short, or grounding through the motor housing, cover it with tape. Where it's hard to wind full-width tape around fine wire, slit off slim

strips and you'll have little trouble.

One type of motor without brushes or commutator will also play dead silently. This is the shaded-pole design easily recognized by two heavy loops of bare copper wire fitted in slots on the stator poles. The stator-connection check just described is the only one you need make with these motors; they have only two wires running from their terminal posts.

If the above checks fail, there's an internal break or burn-out in one of the motor windings. Better let a pro take over.

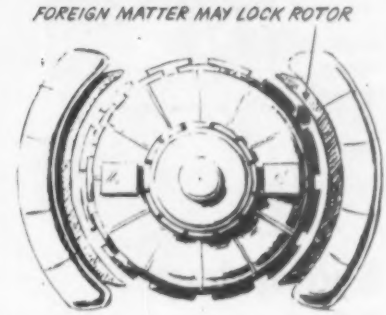
Symptom: Motor won't start, hums

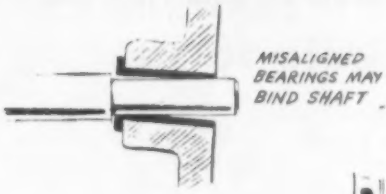
1. Motor jammed? Something inside may be causing a locking action—a loose brush or blower fan, or dirt or grit that's worked its way between a closely spaced rotor and stator. Possibly the bearings have shifted and are badly out of alignment. Again, an attached appliance or tool may have a broken and wedged part, or seized bearings.

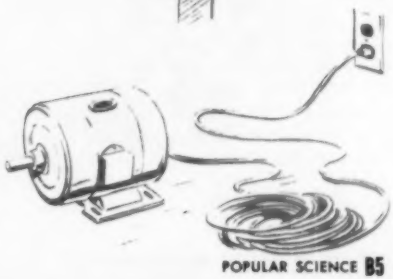
Important: Shut off the current quickly if a motor hums but doesn't run. Then try turning the shaft by hand to make sure there is no mechanical interference or drag.

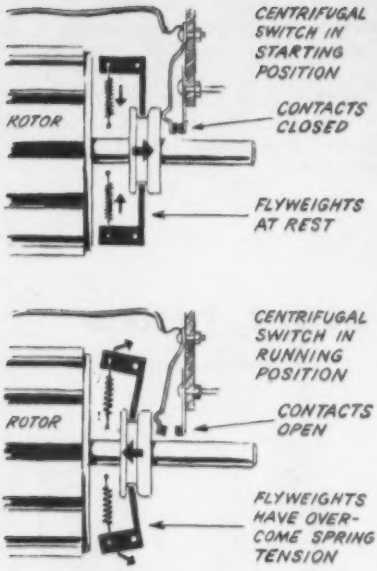
2. Enough juice getting through? A drop in line voltage, a very long extension cord, or one of average length with skimpy wires, may not deliver enough electricity to run the motor properly. Look, too, for poor terminal connections.

3. Are brushes or centrifugal starting-switch contacts doing their job? If there's adequate voltage and the shaft turns freely, a low hum tells you that current is getting through some windings but not others. Give motors with brushes and commutators the same internal checks you would the





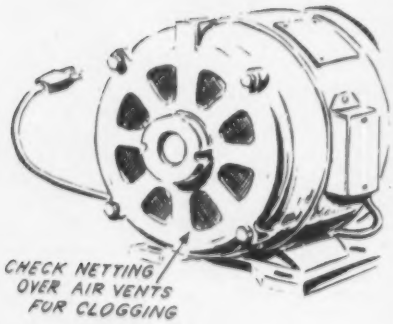




silent kind (see paragraphs 3, 4 and 5 in the preceding section).

If a motor has no brushes and commutator, you'll find four wires taking off from its terminals. (One exception is the shaded-pole type already described.) One pair leads to the main, or *running* coils of the stator. The other two are connected, by way of a centrifugal switch on the major shaft, to a second set of stator windings called *starting* coils. Check the switch; it looks much like any other governor. In the starting position, juice is directed through the starting windings. Then, as the motor revs up, a pair of weights fly out, compressing a spring and breaking the contacts. Gum on the shaft, or washers that project too far, may be holding these contacts apart at all times. Clean the shaft with kerosene applied with a brush; then oil sparingly. Or remove a washer that prevents contact. Sandpaper contacts lightly if they're dirty.

Symptom: Motor overheats, or blows fuses



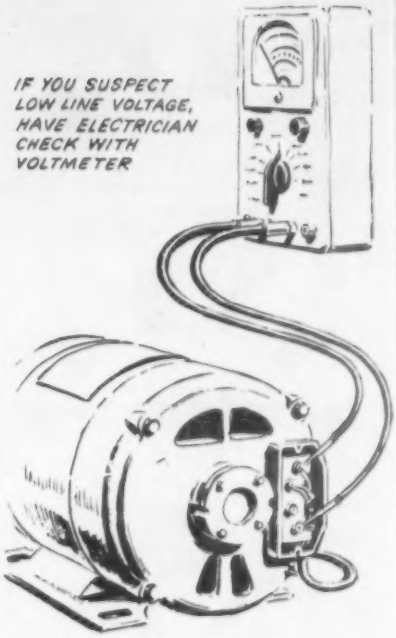
1. Can it "breathe"? Most motors need a flow of air through their housings to keep them cool. In one that has netting or perforated sheets behind the air vents in its end plates, make sure this screening isn't clogged with dirt and dust.

2. Are bearings dry or improperly aligned, or is a rotor dragging? Stiff bearings impose an unnecessary load on a motor. Loosen the bells, and try shifting them. Where a flange on the housing prevents this, try snugging up the bolts. If one or more of them

is loose, the bearings may be in a plane not perpendicular to the shaft. A dragging rotor may be due either to misaligned or worn bearings. In the latter case, you can have them replaced or rebushed if the motor is worth it.

3. Is enough voltage getting to the motor terminals? See paragraph 2 in preceding section. A motor that isn't fed enough voltage may draw more current than it can safely handle. Assuming it's on a properly fused circuit, the fuse will blow. If the fuse has too high a rating, the motor will burn out.

4. Is current getting through all the windings? Conditions that block a flow of current to or through a coil may not stop a motor. But other windings will work harder than they should. Eventually, they will destroy themselves. You've already learned what checks to make to spot a dead winding.

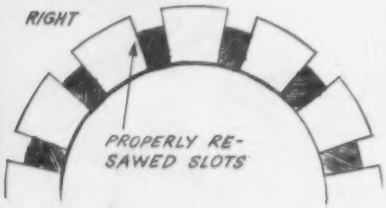


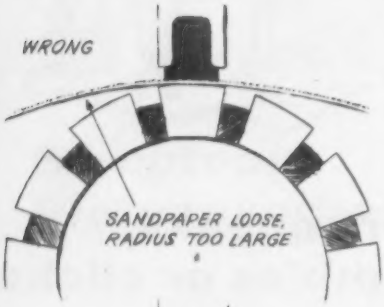
Symptom: Motor squeaks, rumbles or clicks

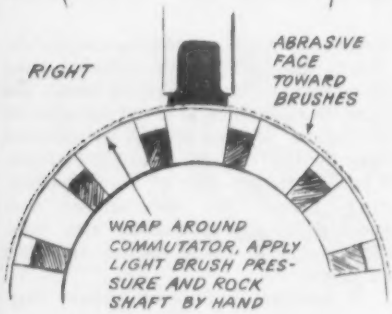
Look for stiff bearings. This is a major cause of motor squeaks. A motor that rumbles either has worn bearings or an out-of-balance rotor.

Clicks, except for the reassuring kind that tell you that a starting switch has just broken contacts, indicate brush or commutator troubles. They will be accompanied by excessive sparking. Turn the shaft by hand. Possibly the brushes are stubbing their toes against high mica insulation between the commutator segments. Again, the soft brush material may have worn down to a point where the hard brush-holder is dragging against the drum. Brushes should be replaced long before they are reduced to nubs. Apart from the risk of holders dragging against the commutator and scoring it, spring tension may ease off enough to cause arcing and loss of power.

If brushes don't seat against seg-

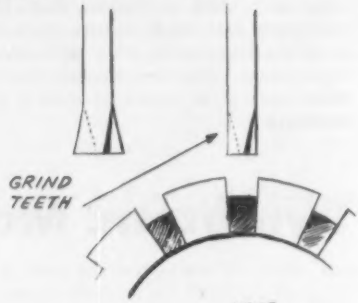


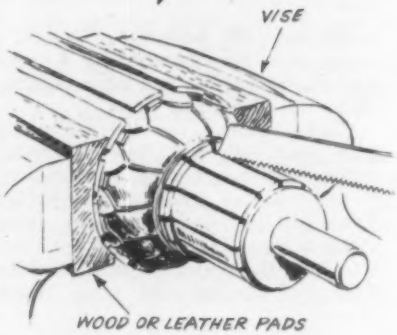




ments correctly, or if you are replacing them, take a strip of fine sandpaper—not emery cloth—and wrap it about the commutator, abrasive side out. Then rotate the shaft by hand. At the same time, press lightly on the brushes. This will produce matching concavities on the brushes. Wipe away any trace of grit before you reassemble the motor. When doing this, make sure the holders are properly aligned.

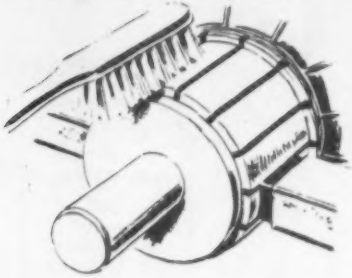
If mica has crept up between the commutator segments and is striking the brushes, break off the end of a hacksaw blade and grind away its tooth set. Pull the rotor assembly out of the motor and, clamping it in a vise with protective pads of wood or leather, resaw the slots between segments.





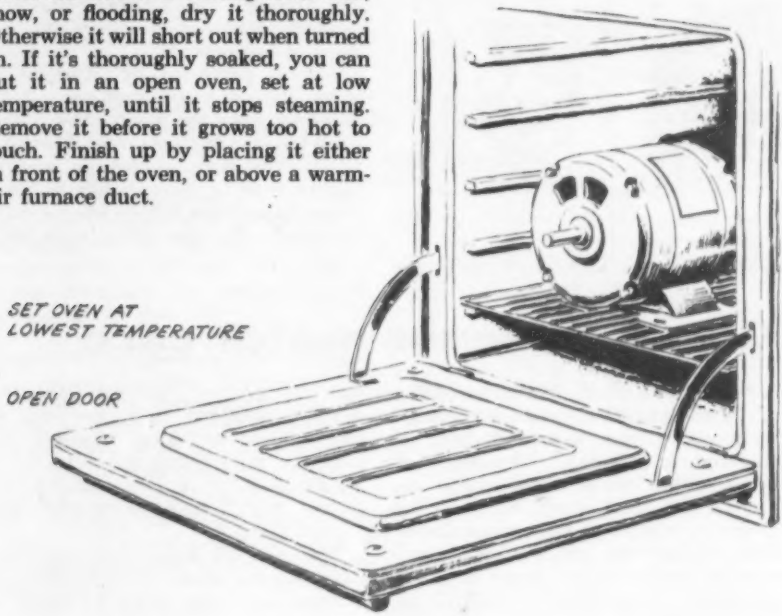
Spare the oil

Over-oiling leads to trouble. When brushes spark and a motor loses power, it could be excess oil. Oil, itself, is a fairly effective insulator. Combined with the dirt and dust it attracts, it forms a tough film that won't let current pass. The best cure is a brisk rubbing of the commutator with carbon tetrachloride.

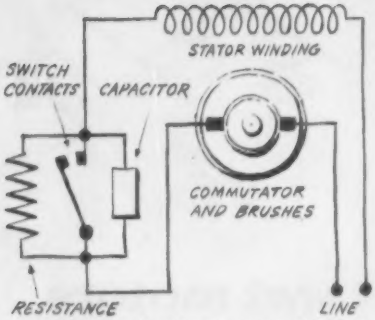


What to do about wet motors

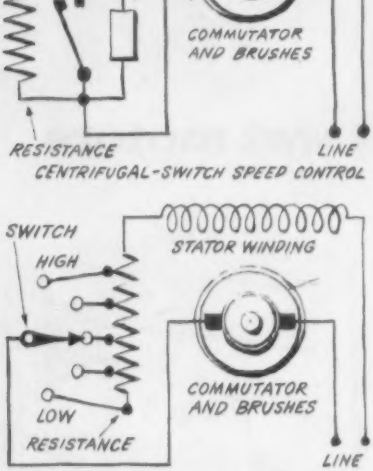
Motors must be kept dry. When a motor has taken a beating from rain, snow, or flooding, dry it thoroughly. Otherwise it will short out when turned on. If it's thoroughly soaked, you can put it in an open oven, set at low temperature, until it stops steaming. Remove it before it grows too hot to touch. Finish up by placing it either in front of the oven, or above a warm-air furnace duct.



Speed-control devices giving trouble?



CENTRIFUGAL-SWITCH SPEED CONTROL



TAPPED-RESISTANCE SPEED CONTROL

Built-in gadgets. Some motors have devices offering various speeds (cake mixers, for example). Two systems may be used. As revs build up in one, a centrifugal switch opens, forcing current to flow through a resistance coil. This slows down the motor until the points close again. A control knob changes spring tension on the points, making them open at higher or lower speeds. Check it for proper mechanical adjustment and clean the points.

In the other type, there's a tapped resistance, cut into the stator winding. A control switch trims down juice passing through the winding. Check its contacts. Sandpapering may put them back in business.

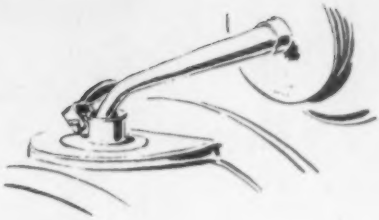
Motors protected by overload devices have cut-out switches. If the windings draw too much current, they open the circuit. Some reset themselves when conditions return to normal. Others must be reset manually. Don't forget to push the button when a motor equipped with the latter type plays dead.

Common-sense motor care

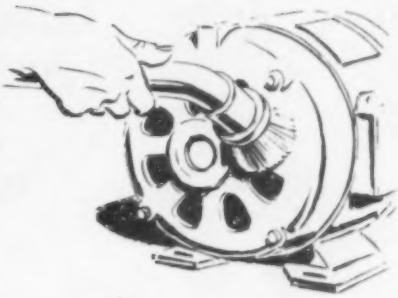
Lubrication. Overenthusiastic oiling and greasing probably knock out more home motors than abuse. Working its way into commutators, brushes and other contact surfaces, the excess can attract dirt and dust, bonding the particles together to form an insulative film that puts the contacts out of commission. Lubricate all motor bearings sparingly. A few drops of SAE 20 oil for 1/6 hp. up, or the water-thin variety, packaged in squirt cans for the midgets, will keep bearings running free for months. So will a single clockwise twist of a grease-cup cap. Leave the lubricated-for-life type strictly alone.

One more tip. Bearing oil cups often have filtering wicks. Occasionally one of these may clog. When oil backs up

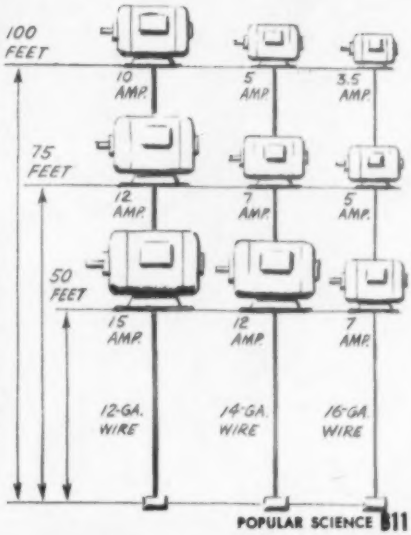
behind a wick, remove the felt or other filtering materials carefully with tweezers, and wash it in kerosene. Then let it dry before putting it back in the cup and replenishing the supply of lubricant.



Vacuum out the fluff. You've seen how dirt and dust may stall a motor, cause overheating or build up an insulative film. They can do it, even without help from excess oil. This kind of fluff also presents a fire hazard. Dirt will cause excessive brush and commutator wear. Keep your motors clean. Vacuum the larger ones, and use a soft brush to dust off the small ones. Don't neglect the midgets tucked under phonograph turntables, in the housings of slide projectors and other hard-to-reach spots. It may be convenient to forget them, but house dust doesn't and is more than a match for their flea-power.



Extension cords. A further word of caution about these. Never put a motor farther than 200 feet from a power outlet. Use the drawing as your guide to the right wire size. And, finally, remember that good insulation pays off. Use SJ type cord for moderate duty, and type S for heavy service or where the cord is subject to oil or abrasion.



Danger in power-line low voltage. If a storm disrupts electric service, switch off such automatic-control AC motors as those in pumps, freezers and the like. Reason: As service is restored, full voltage may not come through the line. This won't hurt the lights—they'll simply flicker or burn dimly—but it can cause motor burn-outs if they are permitted to run on insufficient voltage.

7 Extra Uses for

P.S. EXTRA: YOUR TEAR-OUT BOOKLET NO. 13

To remove this booklet, place your left hand on the facing magazine page, grasp the booklet with your right, and pull it gently away.

After reading, file for future reference. You'll find it valuable on many home jobs.

February 1959

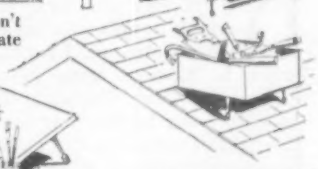
POPULAR SCIENCE

7 Extra Uses for Door Bumpers

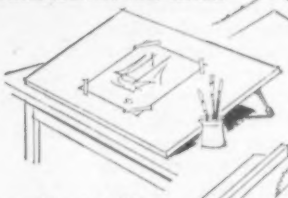
SLIM and durable, with a screw on one end and a non-slip rubber tip on the other, door bumpers are ideal for many jobs. The newer spring type has an added advantage where extra-soft resistance is needed. Get as many as you need at the dime store, in a variety of styles and shapes.

TO RAISE A CHAIR to suit a small child at the table, install a bumper on each leg after removing the glides. Putting bumpers on the legs makes it handier to paint a chair, too.

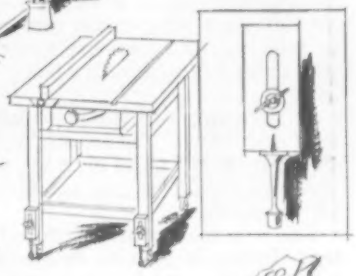
FOR WORK ON A ROOF, a tool box can ke kept level, and won't slide, if you turn two bumpers into the bottom near the end. Locate the bumpers to suit the roof pitch.



A DRAWING BOARD becomes a convenient drawing table when you place two of the bumpers near one edge to support it at an angle.

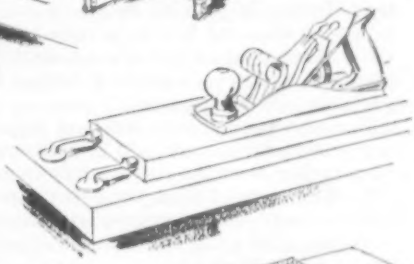


PREVENT CREEPING of a power-tool stand by installing bumpers on adjustable blocks on two of the legs. When the tool is in use, lower the rubber cushions against the floor and lock the blocks with wing nuts.

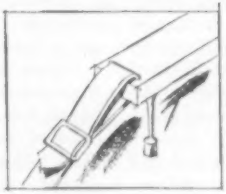


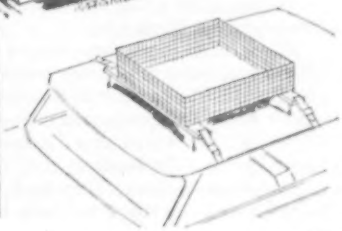
SCRATCHES ON A KITCHEN WALL caused by a table being pushed against it won't be a problem any more if bumpers are fitted to the table.

A GOOD BENCH STOP that will prevent side slippage of stock being planed can be made from bumpers. Heat the necks and bend at right angles to the screw portions.



A LUGGAGE RACK atop a car can be supported with four bumpers in the absence of the usual suction cups. Tie-down straps will secure it.





Money-saving advice on when and how to go about

Getting the Best Brake Job

By Phil McCafferty

DRIVE any car long enough and you're bound to need a brake job. That's obvious. Exactly *when* you ought to have it done is not always obvious, however. Neither is the extent of the work your brakes may need.

Engineering advances have made brakes much better in recent years. But sloppy repairs can cancel out these improvements. And you can waste money getting the full treatment when you don't need it.

Mileage can be a tipoff to when you need new linings. The average driver gets 25,000 to 30,000 miles on a set, but long runs and careful driving habits can double the figure.

Don't be too optimistic, though. Stop-start driving in the city or crowded suburbs may wear out linings in only 10,000 miles. Heavy-footed drivers can do it in half that distance, even less if helped by an automatic transmission.

Can you stop? That's the most important question. It's easy to tell whether your brakes meet the usual safety standard. With good brakes on a dry, level paved street, your passenger car should stop within 19 or 20 feet after you apply the brakes at 20 m.p.h.

If you need more than 26 feet to stop at this speed, your brakes are in a dangerous condition. The hooker is that you'll need about two car lengths more to stop at 40 m.p.h. At 80 m.p.h. you'd travel at least seven car lengths farther.

Judging condition. How brakes feel and sound can be a tipoff to their condition.

What to look for

A low brake pedal that must be pumped up indicates the need for adjustment—but not necessarily new linings. A low pedal that can't be pumped up usually means not enough brake fluid.

When the pedal sinks steadily but slowly under moderate pressure, the master cylinder is probably worn. A spongy pedal is caused by air bubbles in the system. Bleeding the system, a $2 job, will make the pedal firm.

A need to floor the pedal to stop the car indicates that the brakes must be taken up, a simple adjustment.

Squealing brakes can mean that linings are worn so thin that the rivets rub against the drums. It can also mean excessive dust in drums and countersunk rivet holes, a glazed lining or a lining saturated with grease or brake fluid.

VISUAL CHECK of brake parts after the drum has been removed will tell you if a brake job is about due. If you don't want to pull the wheel yourself, have the wheel bearings repacked at the next grease job. Then you can check brakes while a $2 packing job is being done.

When driving on a quiet, narrow street or when passing under an underpass, listen closely for a wire-brush sound. This means a dragging brake shoe.

A pull to one side in stopping has been experienced by almost everyone. This may happen when one or more of the linings has become wet during a rain or from driving through puddles.

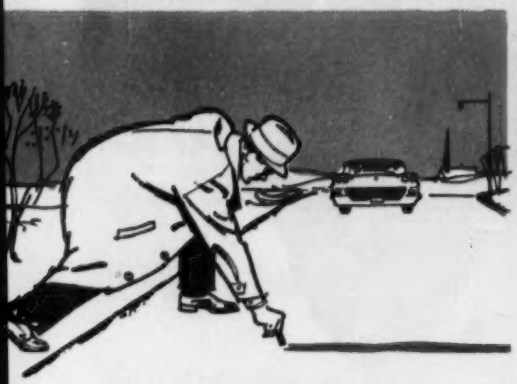
Under ordinary conditions, however, the pull indicates that a lining may be glazed from hard use, soaked with leaking brake fluid or smeared with grease from the wheel bearing. A drum scored by dirt will reduce brake effectiveness too.

Do they need relining? Pulling the wheels off is the surest way of finding whether you need a reline job. The service-station mechanic will probably do this for a dollar or so, and he can clean and repack the wheel bearings while they're exposed.

These are things to look for:

- *Worn brake linings.* Manufacturers recommend replacement when linings are worn to within 1/32″ of the rivet heads, but this is like replacing tires that are worn, but not bald—there's still plenty of safe mileage left. Aside from squealing, the brass rivets won't damage the drums, even though they make contact. It's dirt and grit in rivet recesses and along the leading edge of the shoes that cause scoring. Bonded linings should be replaced when only 1/32″ or less remains.
- *Burned linings.* Blackened linings suggest they've been overheated to the point of being charred. Normally hard, linings that are charred will crumble easily under the probing tip of a pen

How to road-test your brakes



1 **DRAW A CHALK LINE** across the paving of a dry, level and deserted street.

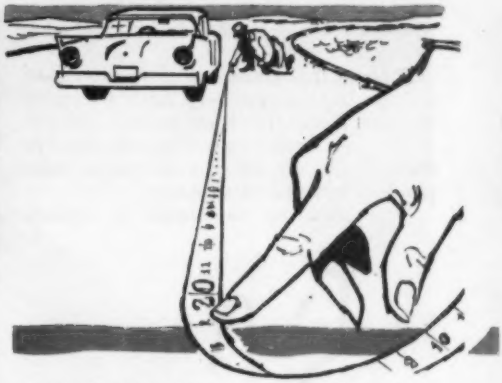
2 **DRIVE UP TO THE CHALK LINE** at 20 m.p.h. Have a friend stand at the line.

How to Spot the Service Your Brakes Need

Improper or uneven brake adjustment can be the culprit in nearly every case listed. Have the adjustment checked first.

SYMPTOM	POSSIBLE CAUSE	SERVICE YOU NEED
SPONGY PEDAL	Air in system	Bleed brakes, check leaks
	Drums distorted or worn thin	Turn or replace drums
	Clogged master-cylinder vent	Clean vent
BRAKES FADE	Wrong or inferior linings	Replace linings
	Inferior brake fluid	Flush and replace fluid
	Internal master-cylinder leak	Rebuild or replace unit
BRAKES GRAB; CAR PULLS TO ONE SIDE	Bad wheel bearings	Replace
	Loose backing plate(s)	Tighten bolts
	Brake fluid or grease on linings	Clean or replace linings
	Distorted or scored drum(s)	Turn or replace drum(s)
	Heat-damaged linings	Replace linings
HARD PEDAL, POOR STOPPING	Glazed linings or drums	Cut glaze by sanding or replace
	Pedal or brake linkage binding	Free parts
PEDAL GOES TO FLOOR	Fluid reservoir empty	Add fluid, bleed system
	Leaks in system	Check and repair
BRAKES ON ONE WHEEL DRAG	Distorted wheel-cylinder cups	Replace
	Restricted fluid line	Clean and replace
	Broken or weak return springs	Replace
	Emergency brake linkage binding	Free and adjust (rear only)
BRAKES ON ALL WHEELS DRAG	Weak return springs	Replace
	Insufficient free pedal clearance	Adjust
	Swollen piston cups	Replace cups and fluid
BRAKES SQUEAL	Glazed lining	Replace linings (try sanding first)
	Rivets (or shoes) contacting drum	Replace linings
	Excessive dust in drums	Clean drums
	Front suspension loose	Tighten or rebuild
	Drum damping springs loose or missing (on cars so equipped)	Repair or replace

3 HIT BRAKES HARD when the friend signals that front bumper has reached the line.



4 LEAVE CAR WHERE IT STOPS and measure from the chalk line to the front bumper.

The results

A STOPPING DISTANCE of 20 feet or less means that the brakes are in good condition. A stopping distance of 26 feet or more means that the brakes are dangerous, perhaps illegal. Note, too, if the skid marks on the road are the same length, to be sure one brake isn't loafing on the job.

knife. Replace them as soon as possible.

- *Brake-shoe return springs.* These should be under firm tension even though the shoes are fully retracted. If convenient, compare them with new ones. If yours are longer, they should be replaced for crisp return. Caution: Don't pump the brake pedal with drums removed; with nothing to limit travel, you'll force the innards right out of the wheel cylinders.
- *Flexible brake hoses.* With the wheels off, it's easy to reach around behind the backing plate and inspect the hoses. If not firm and free of cracks, replace them.
- *Scored drums.* If the inside surfaces of the drums are grooved or deeply scratched, you need a brake job that includes turning to remove the grooves. No matter how much lining remains, scored drums reduce brake efficiency.
- *Leaking wheel cylinders.* Wetness *outside* the rubber boots at either end of the cylinders calls for honing the bore or complete replacement. One or two honing jobs is par for a cylinder. A thin film of fluid *under* the boots does not mean trouble.

You may save a brake job or at least postpone it by doing some minor maintenance while the drums are off. Brush out dust, particularly at the rivet recesses and along the shoe ends.

(A tip for the future: If you're ever forced to drive through hubcap-deep water, remove all drums within the following few days and clean out the grit carried into the brake system by the water. Failure to do this is a common cause of scoring and the ruination of perfectly good brakes.)

If linings appear glazed but sound, you can restore their effectiveness by sanding their surfaces with medium sandpaper. A brake-fluid-soaked lining may stop slipping after a good soaking in alcohol, and a grease-smeared one may come clean after a bath in gasoline. But don't forget to repair the wheel cylinder or grease seal that caused the leak. If a driving test shows no improvement after washing the linings, they must be replaced.

Where to go for a brake job. If you do not know of a completely reliable shop, check around. Ask for quotes on a reline job without extras and compare prices. But don't sacrifice quality to save money. Brakes are too important.

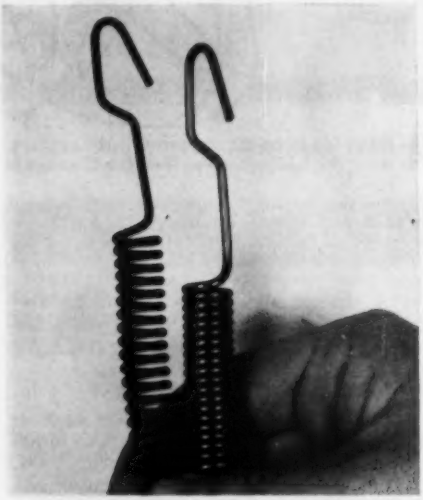
Beware of unknown brake shops that urge you to leave the car and "pick it up later." If you can't be on hand to watch the inspection and repairs being made, insist beforehand that you will pay only for labor and parts that you authorize. This is not unreasonable. A good shop can tell in less than 15 minutes

what repairs are needed, and explain why.

What kind of lining? You have a right to ask the brake man whether he intends to use riveted or bonded linings and what brand they will be.

Linings that come out of an unmarked box should immediately flash a mental warning signal. Insist on genuine replacement parts from the auto manufacturer or their equivalent from a reputable independent auto-parts supplier.

You may be pressured to replace



SHOE-RETURN SPRINGS can lose much of their tension. In a brake job, it's wise to have the length of the old springs checked against new ones. New springs cost only a few cents.

riveted linings with bonded ones. Bonded linings, the argument goes, last longer because you can wear them down closer to the brake shoes; there are no rivet heads to squeal and collect dust.

Many shops prefer to use linings bonded to replacement shoes because they can turn out more jobs per day. Today's bonded linings are dependable. But consider these points when making your choice:

- A bonded lining, rigidly cemented to the entire surface of the shoe, tends to make the pedal feel "hard." With power brakes, this makes no difference, but without the power assist, you might feel that it takes too much pressure to stop. Riveted linings make the pedal feel softer.
- You get back different shoes with bonded linings. There's nothing drastically wrong with this, for the lining eventually wears in to fit the radius of the drum. But your old shoes fit perfectly, and if they're marked, relined in the shop with riveted linings, and replaced in their original position, you come out with a perfect set of brakes that will require a minimum of break-in. There should be no extra charge for relining your own shoes.

Unless wheel cylinders are serviced during a brake job there's one chance in five that you will have trouble within a month. That's because new, thicker linings make the expander pistons work near the center of the cylinder again. They probably have not worked here for some time.

Meanwhile, if there was water in the brake fluid it has probably pitted the cylinder wall in this center section.

As the feather-edged rubber cup on the piston slides over the pits, it becomes frayed and a leak results. Caught in time, before the lining becomes fully saturated with fluid, washing with alcohol may save it and you'll pay only for belated reconditioning or replacement of the wheel cylinder. But if the lining is spoiled, don't expect a new set for free if wheel-cylinder service wasn't included in the original job.

Drums can be turned only two or three times, after which they should be replaced. There have been cases where the flange of a too-thinly-turned drum separated from the face during a panic stop. The brakes pressed futilely against the disconnected band, while the wheel rolled on unchecked. If drums are already .040″ or more under size, replace them rather than run on a weak link between the brakes and the road.

The mechanic may try to sell you a set of "screen-door springs," which wrap around the outside of the brake drums to damp out squeal and wire-brushlike noise. They'll do no harm, and if drums have been turned, or bonded linings installed, they might be worthwhile. They contribute nothing to cooling the brakes, however, so don't be taken in by a hard sell in that direction.

Do you always need the works? Not always. Linings on the front wheels frequently wear thin before the rear linings need replacement. Don't be bashful about asking for only a front-wheel reline. Fleet

[*Continued on page 268*]

With Champion spark plugs, fire engines roll instantly!
Above: Garden City Park (L. I.) fire department.

Q. *ALL* major fire engine makers use Champion spark plugs. *Why?*

A. With fire engines, every call is an *emergency*. And Champions deliver the instant starts and completely dependable power fire engines must have. To get this performance in your *car*, put in Champions every 10,000 miles!

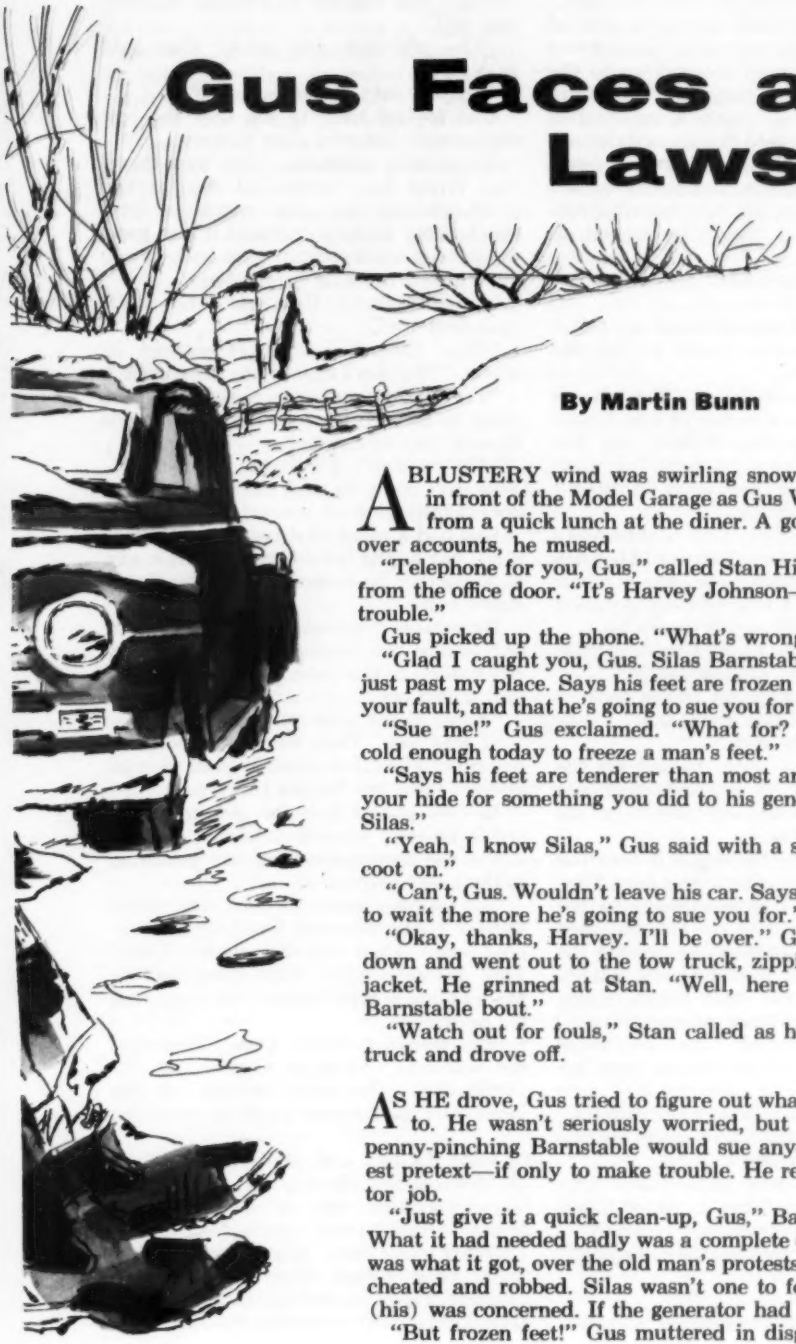
World's favorite spark plug—engineered for every car built by Ford, General Motors, Chrysler, American Motors, Studebaker-Packard and every major foreign maker.

CHAMPION

Gus picked up Barnstable's scrawny figure and carried him to the truck.

snow flicker down ahead. "The old fakes." "Forgot you insisted on putting in a new

Gus Faces a Lawsuit



By Martin Bunn

A BLUSTERY wind was swirling snow along the street in front of the Model Garage as Gus Wilson came back from a quick lunch at the diner. A good day for going over accounts, he mused.

"Telephone for you, Gus," called Stan Hicks, his assistant, from the office door. "It's Harvey Johnson—and sounds like trouble."

Gus picked up the phone. "What's wrong, Harvey?"

"Glad I caught you, Gus. Silas Barnstable's car is stalled just past my place. Says his feet are frozen solid, that it's all your fault, and that he's going to sue you for all you're worth."

"Sue me!" Gus exclaimed. "What for? Anyway, it isn't cold enough today to freeze a man's feet."

"Says his feet are tenderer than most and that he'll have your hide for something you did to his generator. You know Silas."

"Yeah, I know Silas," Gus said with a sigh. "Put the old coot on."

"Can't, Gus. Wouldn't leave his car. Says the longer he has to wait the more he's going to sue you for."

"Okay, thanks, Harvey. I'll be over." Gus put the phone down and went out to the tow truck, zipping up his leather jacket. He grinned at Stan. "Well, here I go for another Barnstable bout."

"Watch out for fouls," Stan called as his boss got in the truck and drove off.

AS HE drove, Gus tried to figure out what old Silas was up to. He wasn't seriously worried, but he knew that the penny-pinching Barnstable would sue anyone on the slightest pretext—if only to make trouble. He recalled the generator job.

"Just give it a quick clean-up, Gus," Barnstable had said. What it had needed badly was a complete overhaul, and that was what it got, over the old man's protests that he was being cheated and robbed. Silas wasn't one to forget when money (his) was concerned. If the generator had failed . . .

"But frozen feet!" Gus muttered in disgust, watching the

snow flicker down ahead. "The old faker."

The car had stalled at the far end of Harvey Johnson's property. Gus swung the tow truck around, backed up to the Barnstable sedan, honking his horn. When there was no reaction, he climbed down and approached the car window on the driver's side. Silas sat hunched down behind the wheel, his coat collar turned up around his ears, his thin, irascible features set in sullen lines. Gus tapped on the glass.

"Open up, Barnstable!" he shouted.

BARNSTABLE straightened up, rolled down the window, peered at Gus like a snapping turtle.

"Sabotage!" he shrieked. "I've always suspected you ran a racket at that Model Garage of yours, Gus Wilson, but this cinches it. Soak me for a generator overhaul I didn't need, and what happens?"

"Take it easy, Silas."

"Don't Silas me. You deliberately rigged that generator so this would happen and you'd get another expensive repair job. That's what I told Harvey Johnson and that's what I'll say in court."

"Never mind that now," Gus said. "Get into my truck; I'm towing you in."

"A man can't walk on frozen feet, or didn't Harvey tell you about that? I may be maimed for life and . . ."

Gus opened the door, picked up the scrawny figure in his arms, carried him to the truck, plunked him down in the seat, still screaming.

". . . before I'm through I'll own the Model Garage, lock, stock and barrel."

As he ranted, Gus climbed into the stalled car and tried to start it. Satisfied that the battery was dead, he hoisted the front end up with the tow-truck winch, took his seat in the truck beside Barnstable, and headed back toward town.

"Turn that heater off. Don't you know better than to thaw out frozen flesh too fast?"

Barnstable was silent for a few minutes, then stormed again. "Just wait till my lawyer hears about this."

"Maybe I did slip up somewhere," Gus admitted honestly. "But a lot of other things may have caused your trouble."

"Like the generator regulator, maybe?" Silas suggested.

"Could be."

"Got you there," Barnstable snapped. "Forgot you insisted on putting in a new one, eh?"

"The old one was shot," Gus said patiently.

"So you said. Anything else?"

Gus looked back to see that the tow was secure. "Maybe your battery . . ."

Barnstable chuckled. "Got you there, too. When you harpooned me for the overhaul and the new regulator, you checked my battery and said it was good for at least another year. Now look at me, all crippled up with frozen feet."

"I doubt that," Gus said, "but we'll soon find out."

"Hey, there!" Barnstable sat up in alarm. "This isn't the way to the garage."

"I'm taking you to the hospital. If I'm going to be sued for frozen feet I want to be sure they're frozen."

"No you don't. I'll doctor my own feet. You ain't going to stick me for expensive doctor bills atop of everything else."

Gus had a mind to drive on to the hospital, but as the old fellow seemed ready to jump out, he turned toward the Barnstable home.

Barnstable protested again. "You're not taking me home, either. I'm going right along to the garage to see you don't pull a fast one."

"What about your poor feet?"

"I told you. They have to be thawed out slow. They'll do that in your garage, at least until my lawyer gets there."

As Gus pulled into the garage, Barnstable lowered himself carefully, shuffled across the floor, grimacing and groaning, to the telephone and dialed.

"No monkey business, now," he yelled at Stan Hicks, who was lowering the crippled sedan. Then into the phone: "Dore? This is Barnstable. Get down to the Model Garage right away. I'm suing Gus for my feet."

Stan whistled. "Tom Dore! That shyster will take you apart, Gus."

"Maybe," Gus said, taking off his jacket and reaching for a pair of coveralls.

TOM DORE was there in less than five minutes. He was tall, gaunt, long-legged, looking like a stork peering through thick-lensed spectacles.

"What's all this about your teeth, Silas? Gus Wilson been knocking you around? That's malicious assault. We'll get a dentist—expert testimony—and . . ."

"Feet—feet, not teeth," Barnstable corrected irritably, pointing a trembling finger at Gus. "My feet got froze when the generator that scoundrel sabotaged conked out and stalled my car in this blizzard. And if that isn't enough . . ."

"Watch your tongue, Silas," Dore admonished. "Frozen feet are good enough. We'll sue."

"For $10,000," Barnstable added.

"Not so fast," Gus said, lifting the hood of the car. "First let's see what's wrong and who's to blame."

"Watch him, Dore, he's slippery."

Stan gave a derisive snort. "If Gus is to blame he'll admit it. Just try to get any jury from around here to believe otherwise."

"Hmm, maybe you're right," Dore admitted. "Well, Gus, just what *is* wrong?"

"I'll have to look," Gus said.

He checked the battery terminals; they were tight and not corroded. A hydrometer test showed the battery very low. A voltmeter said that it would take and hold a charge. Pulling the cover off the generator frame he brought over a trouble light: no sign of thrown solder, burned wires or loose armature segments, no jumping brushes. He was replacing the frame cover when he paused, looked closer.

"Come, come," Dore urged. "What's the verdict?"

"Generator okay," Gus reported, "but I think I've spotted the trouble." He reached over to the firewall with a screwdriver and removed the cover of the generator regulator. "There's your trouble," he said, "the regulator. Look at those voltage contact points."

BARNSTABLE beamed. "Make a note of that, Dore. Gus installed that regulator—a new one, too."

"That's right," Gus admitted. "But I didn't install that radio and it wasn't there when I did the generator job."

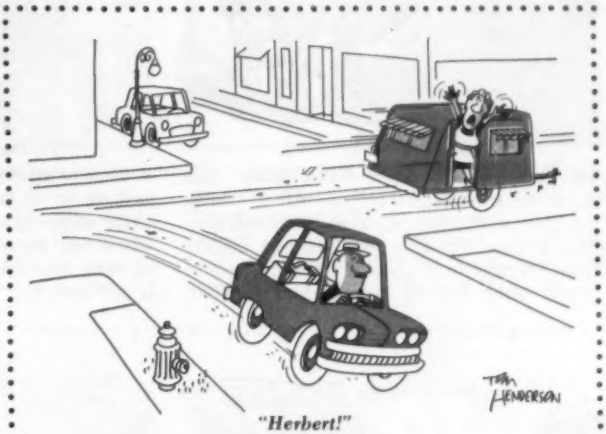
"Darn tootin' you didn't install it. Bought it at a cut-rate store and put it in myself. That's why it works—or did until my generator went out."

"Make a note of *that*, Dore," Gus said, "and take a look here." He held the light over the generator. "See, this is a radio-suppression condenser. It's attached to the generator terminal here, which is the field terminal, not to the armature terminal where it belongs."

"So what?" Barnstable asked. "The radio worked."

"Sure, at the cost of damaging the voltage-regulator points. That's why your battery went. Any mechanic will back me up.

"You know, Mr. Dore," Gus continued, a twinkle in his eye, "Barnstable has made some pretty serious accusations—in front of witnesses—defamation of character, slander."



"Herbert!"

Dore rubbed his chin and peered at Barnstable through his thick glasses. "Hmm, yes, I think you may have a case, Gus. With a sympathetic jury and good witnesses . . ."

"There's Harvey Johnson, too," Stan said. "I'll bet Silas told Harvey plenty."

"Then," Gus said, "there's the towing fee, my time, a new regulator . . ."

"Now wait a minute," Barnstable shouted. "Maybe I made a mistake. I'll admit it—put it in writing that you did a good job on that generator, Gus. You handle it, Dore, you're still my lawyer."

"What's the matter, Silas?" Gus inquired. "Getting cold feet?" END

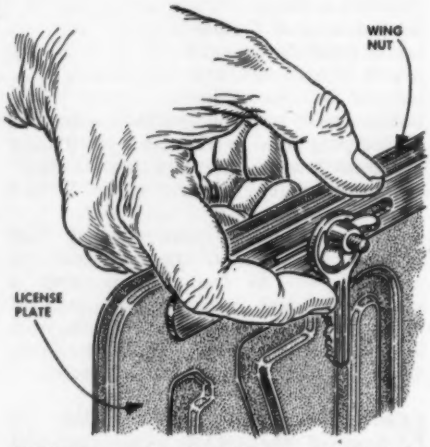
Next month: Gus plants an idea.

Hints from the Model Garage

To remove a frozen light bulb—one stuck in the socket by corrosion—wrap the glass with masking tape. This will provide a non-slip grip and protect fingers from fragments of glass if the bulb should break when forced inward and twisted.

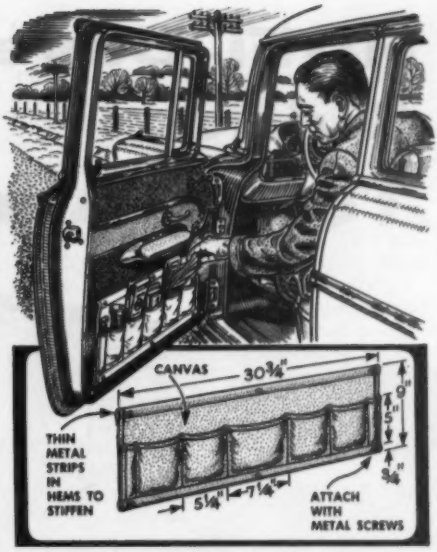
A disk of sponge rubber cemented to the bottom of a paste-wax can will keep it from slipping and scratching the finish when put down. Stick it on with rubber cement, and when the can is empty, peel it off and use it for the next can.

A perfect connection can be made between high-tension spark-plug wires and the terminals of the distributor cap by putting a drop of mercury in each terminal. The mercury closes the gap between wire and contact, preventing corrosion.

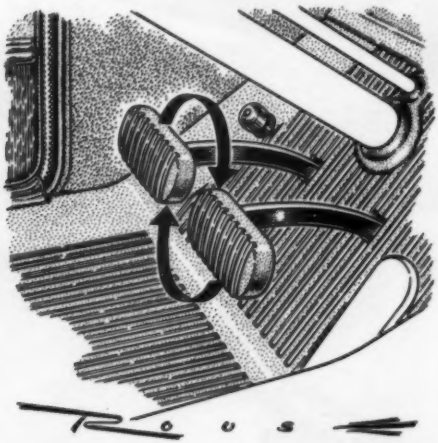


Hiding an extra ignition key behind the license plate may save you a broken vent window if you should inadvertently lock your key inside the car, or misplace it. Enlarge the hole in the key to 1/4" and secure it with the license-plate bolt.

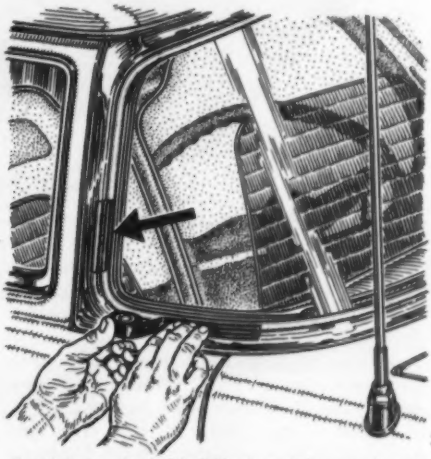
Unused space on the dash can be made usable. If your car has no radio, a map drawer can be made to occupy the space, using the blank dash panel as the drawer front. A clock knockout can be used to face off a king-size pull-out ash tray.



An overcrowded glove compartment can be relieved by storing maps, flashlight, tire gauge and other items in a pocket holder installed on the door beside the front seat. The holder can be stitched from light duck, or made from a shoe bag.



Rubber pads on clutch and brake pedals that show wear on one side can be turned upside down or switched on the pedals to distribute wear. The pads will last longer and there will be less danger of your foot slipping off a worn corner.



Leaking windshield? A quick repair can be made by sealing the gap between the glass and the rubber gasket with plastic electrician's tape. Applied carefully and left undisturbed, the tape makes a permanent repair that doesn't look patched.

Hi-Fi Buyer's Guide: Tone Arms

By Hubert Luckett

TONE arms can cause more distortion than you might save by spending an extra $100 on your amplifier. Experts have been taking a closer look at their design, now that the new stereo records have made their faults even more noticeable than they were before.

Result: a new crop of tone arms and redesign of several older models. Performance is noticeably better on the average. Fortunately, design factors that make an arm better for stereo also make it better for monophonic records.

The seeming simplicity of the tone arm is deceiving. It has a theoretically impos-

sible job in reproducing recorded sound. Ideally, it should:

- Hold the pickup absolutely stationary while the wiggles in the record groove move the stylus from side to side (and up and down, too, in the case of stereo).
- Let the spiral groove carry the pickup across the record without causing the stylus to press harder against one groove wall than the other.
- Maintain intimate contact between the stylus and groove without exerting enough pressure to deform or wear the groove.
- Hold the pickup tangent to the groove at every point on the record.

Hi-Fi and Electronics

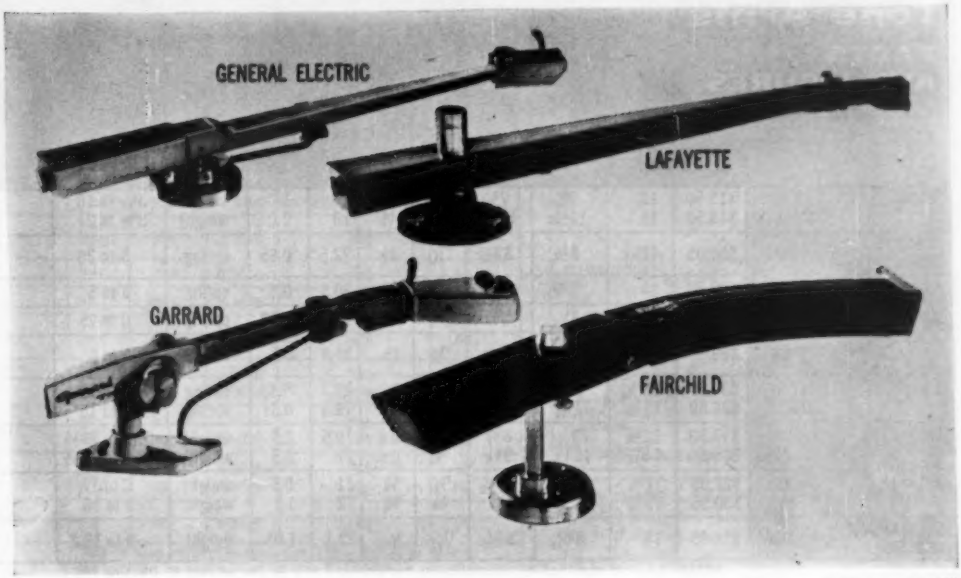
While complying with these mechanical and geometric demands, the arm must stolidly resist any sympathetic vibrations on its own. It must combine the rigidity of a brick wall with the delicate touch of a feather.

Practical tone arms are necessarily a compromise with conflicting needs. Fortunately, with optimum design, the distortion due to the tone arm can be reduced almost to the vanishing point.

Have weight—will travel. It's the arm's weight that holds the body of the pickup still with respect to stylus vibrations. The arm must provide enough effective mass to be immune to the frenzied activity of the stylus and associated moving elements of the pickup. Now, if we were only concerned with playing perfectly flat and concentric records on precisely level turntables, there would be no problem. Just build the arm like a battleship—make it heavy enough to ride stolidly through the storm of vibrations that the stylus must submit to. This philosophy dominated the design of some highly regarded arms until recently.

But all commercial pressings are not perfect and even the most finicky hi-fier has trouble keeping his turntable and mounting board absolutely level. If the record is warped or the hole is slightly off-center, then the heavyweight arm becomes a foe instead of a friend. Vertical motion of the record surface, due to warp, works against the arm's inertia to send tracking force skyrocketing. Back and forth lateral motions of the arm due to record eccentricity produce destructive side forces with a high-inertia arm.

How light can you make the arm and still provide a stable platform for the pickup? The limit is fixed at the point, at some low frequency, where the weight of the arm will enter into sympathetic vi-



bration with the springiness (compliance) of the pickup. It's the same effect that you get with a toy ball on the end of a rubber band. If you move your hand in just the right rhythm while holding the other end, very small movements of your hand will cause the ball to bounce up and down in a greatly exaggerated oscillation.

If the resonant frequency for the arm and pickup occurs within the range of music on the record, the arm will vibrate violently. The pickup may even jump out of the groove. Below this frequency, output from the pickup drops sharply.

In a good pickup-and-arm combination, this resonance occurs below 20 cycles.

You can check this with a sweep-frequency record such as the Popular Science Test Record No. 1*. If arm resonance is above 20 cycles, you can lower it by adding weight under the pickup and then adjusting the counterbalance for correct vertical tracking force.

Viscous damping can be used to tame tone-arm resonance. The pivot bearings are designed to use a special viscous fluid that gives a controlled resistance to tone-arm motion. Slow movements are practically unaffected but resistance to rapid motion is high. Expert opinion is divided on its desirability. On warped or off-center records, it offers the same drawbacks as high-inertia arms.

The way the weight of an arm is distributed and the method of obtaining vertical tracking force are important, too. Unless the arm is statically balanced about the pivot for lateral motion, gravity will cause it to press harder on one side of the groove when it is slightly off level. This is easy to check. With the tracking force properly adjusted, block the vertical motion so that the stylus will not touch the turntable. Then tip the mounting board slightly. If the arm is statically balanced, it will stay in any position.

For true static balance, the counterweight for the arm must be separately adjustable from the means of supplying the vertical tracking force. Otherwise, the arm will be unbalanced by the amount of the tracking force.

Accidents are more likely to happen with lightweight, delicately balanced arms. A vertical stop is provided on several arms to keep the stylus from hitting the turntable if the arm is dropped acci-

*Available by mail order from Magazine Services, Inc., 355 Lexington Ave., New York 17, N. Y. Price, $3.50.

Tone Arms FACTS AND FIGURES

NAME		PRICE	LENGTH: Overall (inches)	LENGTH: Lateral Pivot to Stylus (inches)	LENGTH: Vertical Pivot to Stylus (inches)	OVERHANG (inches)	HEIGHT OF VERTICAL PIVOT ABOVE RECORD (inches)	OFFSET ANGLE (degrees)	MAXIMUM TRACKING ERROR (degrees per inch)	TRACKING-FORCE ADJUSTMENT: Type	TRACKING-FORCE ADJUSTMENT: Range (grams)
AUDAX	KT-12	$15.50	12	9 9/32	7 5/32	17/32	½	18	1.0	weight	3½ to 18
	KT-16	$18.50	15	12⅛	10	13/16	½	19	2.0	weight	3½ to 21
ELECTRO-SONIC	S-1000	$34.95	12 5/16	8¾	8¾	7/16	½	22.5	0.85	spring	5 to 30
FAIRCHILD	282	$42.50	14	8 23/32	7⅝	½	⅜	20.5	0.5	spring	3 to 6
GARRARD	TPA/12	$19.50	12	8 5/16	9¼	5/16	⅞	22	0.43	spring	0 to 25
GENERAL ELECTRIC	TM-2G	$29.95	12½	9	9	17/32	½	21.8	0.5	weight	0 to 6
GRAY	212 SP	$34.00	12 15/16	9	2 11/16	11/16	7/16	23.7	0.33	spring	0 to 15
	216 SP	$36.50	15⅝	11 1/16	2 11/16	25/64	7/16	19.3	0.31	spring	0 to 15
LAFAYETTE	PK-270	$17.50	12¾	10	8⅛	5/16	n.s.	19.5	2.0	weight	7½ to 13½
	PK-280	$19.50	14½	11½	9⅝	5/16	n.s.	21	1.5	weight	8½ to 14½
REK-O-KUT	S-120	$27.95	12¼	8 25/32	8 25/32	17/32	⅝	21	0.6	weight	0 to 17
	S-160	$30.95	15¾	11¾	11¾	¾	⅝	22	1.1	weight	0 to 16
STROMBERG-CARLSON	RA-498	$24.95	15	8 25/32	8 25/32	17/32	5/16	22.1	1.05	weight	−9 to 18.2

NOTES: n.s.—not specified by manufacturer; * unbalanced only by the amount of tracking force;

dentally. Viscous damping helps here, too, by slowing the rate of fall.

Tracking error and tangency. When the pickup axis is exactly tangent to the record groove, tracking error, and consequently tracking distortion, is zero. When the groove swings equal amounts to either side, the stylus will respond with equal movement of the generating element to which it is attached. This will produce an electrical signal that duplicates the signal engraved on the record. But when the pickup axis is not tangent to the groove, the stylus will no longer move perpendicularly across the groove. Its line of movement will be at an angle and consequently the motion imparted to it by the groove will not correspond exactly to the displacement of the groove.

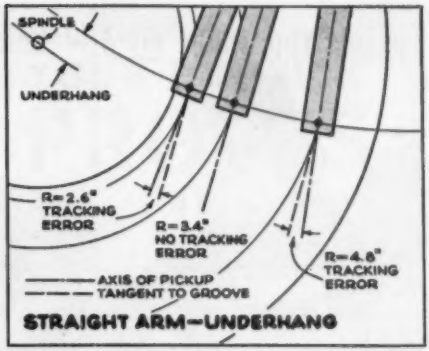
Obviously if the pickup is carried by a straight arm pivoted at one end, at best it can be tangent to the record grooves at only one point. One way to tackle the problem is to make the arm very long.

Longer arms give small angular variation over the required distance. But straight arms of practical length cause unacceptably high distortion.

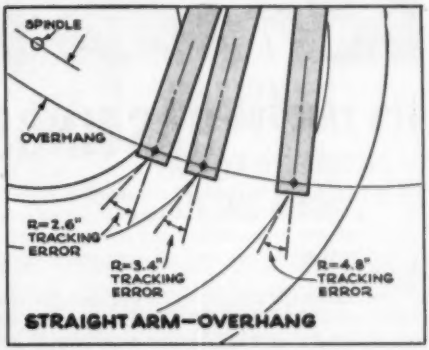
The obstinate facts of simple geometry are licked, in the majority of arms, by an

	STATIC BALANCE?	VERTICAL STOP?	STEREO WIRING	IS HEIGHT ADJUSTABLE?	VISCOUS DAMPING?
	yes[a] yes[a]	yes yes	4-wire 4-wire	shims supplied shims supplied	no no
	yes	no	3-wire	yes	no
	yes	yes	5-wire	yes	no
	no	no	4-wire	yes	no
	yes[a]	yes	5-wire	yes	no
	yes yes	yes yes	4-wire 4-wire	yes yes	yes yes
	no no	no no	4-wire 4-wire	yes yes	no no
	yes[a] yes[a]	no no	4-wire 4-wire	yes yes	no no
	yes	yes	4-wire	yes	yes[b]

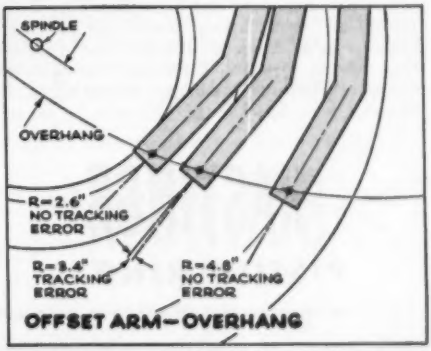
[b] may be used without viscous damping at option of user.



ZERO TRACKING ERROR can be obtained at one point if you "underhang" a straight arm. Error increases when arm moves either way from this point where it is tangent to record groove.



ERROR IS ALMOST CONSTANT even though much larger. The theoretical 10" arm shown here gives least error at 2.6" and 4.8" from record center. The largest error occurs at 3.4".



LEAST ERROR across the whole record is secured by offsetting the pickup to make it tangent at the two minimum points obtained by overhanging. Tracking error is zero at 2.6" and 4.8".

USING TOO MUCH OIL AND GAS?

IT'S TIME FOR HASTINGS

● If your engine has started to use too much oil—look out! It's your first sign of worn-out piston rings. And worn-out piston rings mean power drop-off—costly wastage of gas and oil—expensive repairs later on.

The sooner you act, the less it will cost. See your motor specialist the minute oil-pumping warns you there's trouble ahead. When he recommends new piston rings, ask him for Hastings. They're engineered exclusively for replacement service . . . to provide the additional lubrication worn engines need . . . to stop oil-pumping, save gasoline, restore lost performance.

Get new car power and performance from your present car—with Hastings. Truly your best investment for many thousands of extra miles of trouble-free driving pleasure. Hastings Manufacturing Company, Hastings, Michigan. Piston Rings, Oil Filters, Casite, Spark Plugs.

HASTINGS

PISTON RINGS

TOUGH on oil pumping • GENTLE on cylinder walls

HASTINGS MANUFACTURING COMPANY
HASTINGS, MICHIGAN

ingenious stratagem. First, the arm is mounted so that the stylus overhangs the center of the record by an amount that can be calculated. When the arm reaches beyond the center, the tracking error is made larger—but here's the trick: The range of variation is less. At two points the error is at a minimum and the *difference* between minimum and maximum error will be less.

Now, simply by turning (offsetting) the pickup on the arm, or bending the arm, the pickup can be made tangent to the same grooves at which the minimum error occurs. For two points on the record now, tracking error will be zero. Since the variation in tracking error has been reduced by overhanging, there will be little remaining error across the whole record surface.

Distortion and tracking error. The amount of distortion caused by a given angular tracking error depends on the radius of the record groove. On a 12-inch record, for example, an error of six degrees at the outer groove will cause about the same distortion as two degrees at the inner groove. For best results, the offset angle and overhang are juggled to make the maximum tracking error per inch of radius the same across the record surface. This factor, MTE/inch, could be called the distortion factor of an arm. You'll find it listed in the chart. The smaller the number, the better.

The offset arm is not without penalties. The frictional drag of the record on the stylus creates a force that tries to pull the stylus ahead. The direction of this force is along a tangent to the groove. But the line of the force acting to hold the stylus back is along the line joining the lateral pivot of the arm and the stylus. This tug-of-war between these two forces pulling at angles to each other produces a side force that presses the stylus harder against the inside of the groove.

More offset angle is needed for optimum tracking with short arms. But the greater the offset angle, the higher the side force on the stylus pushing against the inside groove wall. A high side force makes the stylus try to climb out of the groove, so greater tracking force is needed. This is one argument for using the longest arm you can find room for in your installation.

Many unorthodox designs have been

tried to get away from the problems of the single-pivot tone arm. The most successful of these have been the Ortho-Sonic, which uses an overhead trolley to let the pickup glide along a straight radial line, and the B-J, which uses a pantograph linkage with four pivot points to provide an almost straight-line path across the record.

So far, none of these designs has solved all the problems although they work quite well to eliminate the tracking error. In effect, they trade one set of problems for another—equally obstinate.

Mounting the tone arms. This can be almost as important as the original design. Carelessness here can wipe out the value of even the best design. Here's your guide to proper installation:

- Measure overhang accurately. Even 1/32 of an inch can make a difference. Locate the mounting holes with as much precision as you can, then drill oversize holes to allow fine adjustment after the arm is mounted.
- Adjust the height to make the arm parallel to the record surface when the stylus is on the record. (An adjusting device is built into most tone arms. But it's a point worth checking before you buy.)
- Be sure the pickup meets the record squarely. If it is cocked a bit to one side, use shims under one side of the pickup. Best way to check: Align the vertical line on the front of the pickup case with its reflection seen in the record.

In some cases where a manufacturer's tracking error (see chart) seemed substantially higher than average, we calculated the optimum overhang from the measurements given by the manufacturer. We found that the following figures for overhang would give better performance if only 12-inch LP records are to be played:

	Overhang	MTE deg./in.
Audax KT-12	3/8″	.63
Audax KT-16	19/32″	.34
ESL S-1000	9/16″	.47
Lafayette PK-270	1/2″	.4
PK-280	5/8″	.37
Rek-O-Kut S-160	11/16″	.5

The figure for overhang given by Stromberg-Carlson is optimum, but their maximum tracking error would be only 0.5 degrees per inch if it were calculated for LP only. END

HASTINGS
keeps oil clean all the time

See for yourself! If your oil shows dirt before it should—you'd better change to Hastings. Hastings Oil Filter Cartridges keep oil clean from filter change to filter change, when replaced as normally recommended. Proved by tests conducted in accordance with U. S. Bureau of Standards.

Here's the reason: Only Hastings has Densite filtering material. Millions of selected, pressure-packed cotton fibres trap and hold even the most microscopic dirt particles. Your dipstick will prove it!

Next filter change, call for Hastings—for clean oil all the time.

U. S. Patent Nos. 2,797,811 2,584,771

HASTINGS
OIL FILTER CARTRIDGES

HASTINGS MANUFACTURING COMPANY
HASTINGS, MICHIGAN

You turn it on . . . it does the rest!

New Kodak Cavalcade Projector Projects your slides

Now you can relax—be both master showman *and* guest at your own slide shows!

For the new Kodak Cavalcade Projector changes your color slides *automatically*. You can come and go—the show goes on without interruption.

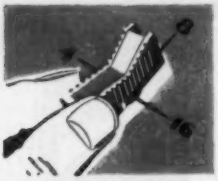
And you can do new things—such as home-taped music and commentary, paced to each show. Guests like this kind of complete showmanship. It's dramatic and *automatic*—easy with the versatile Cavalcade.

Ask your photo dealer to demonstrate the great new Kodak Cavalcade Projector. With sharp *f*/2.8 lens, remote control cord, $149.50 or as little as $15 down. (Price is list, includes Federal Tax, is subject to change without notice.)

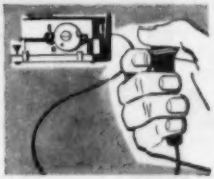
Kodak
TRADEMARK

EASTMAN KODAK COMPANY, Rochester 4, N. Y.

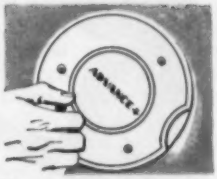
Here are the features that make you master of every color slide show!



You choose from 3 automatic slide change intervals: 4-, 8-, or 16 seconds.



You can change slides by remote control up to 12 feet from projector.

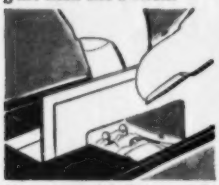


Forward or backward change by control wheel; pushbutton change, too.

You can choose 300- or 500-watt illumination. Just flick the switch.

You can show any popular slide size. New steel guards protect your slides.

Your slides are treated with temperature-controlled air to stay in focus.

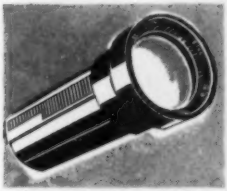


You can edit slides while tray is in projector—remove one slide, replace it.

You arrange and change slide order by checking index window number.

You can point out slide details on screen with the built-in arrow pointer.

changes color slides for you! big-as-life... protects them, too!



You get sharp, brilliant screen images with the 5-inch, *f*/2.8 Ektanar Lens.

You focus your slides smoothly, accurately with the micro-focus knob.

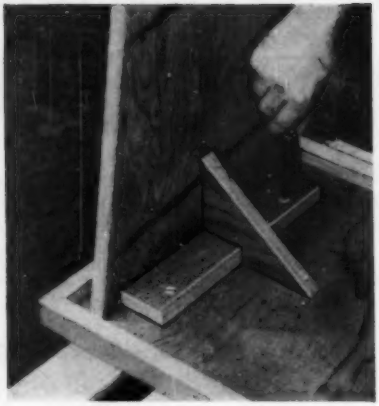
You can preview your slides on the built-in screen of projector's self-cover.

You can remove optical system quickly for cleaning—lamp is easy to change.

See Kodak's "The Ed Sullivan Show" and "The Adventures of Ozzie and Harriet"

Short Cuts and Tips

FROM PS READERS



Desk for Homework and Play

THE base for this handsome, useful child's desk is an unfinished three-drawer chest 27" high of the kind you can find for a few dollars in most furniture departments.

Glue and screw the cleat and corner bracket to hold leg and top in place. Cut the hardboard covering slightly oversize, cement it to the top and trim to fit; then finish with hardwood molding held by glue and finishing nails.—*M. C. Anderson, Arlington, Va.*

As a former serviceman, your skill could be valuable to the U.S. Air Force. If so, the Air Force has an important job and a guaranteed future waiting for you in this new Age of Space. You'll work with the most modern equipment and learn the newest techniques of your specialty. And don't forget: your previous service counts toward rank, pay and retirement income. Talk it over with your local Air Force Recruiter, or mail the coupon.

FORMER SERVICEMEN: YOUR EXPERIENCE CAN MEAN A GUARANTEED FUTURE IN THE NEW AGE OF SPACE

BE A SPECIALIST IN THE U.S. AIR FORCE

PASTE ON POSTAL CARD AND MAIL TO:
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Please send me more information on the Air Force Prior Service Program.

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Short Cuts and Tips

Quick Way to Thaw Frozen Pipes

WHEN you thaw a frozen water pipe with a heat lamp, you can concentrate heat better and faster by using a piece of aluminum foil as a reflector.

Curve the foil and hold it opposite the lamp.—*W. Dale Brown, Marietta, Ohio.*

▶▶▶A TWO-INCH piece of rat-tail file chucked in an electric drill makes a fast tool for enlarging holes in sheet metal.—*Donald MacGregor, Kalamazoo, Mich.*

Tip on Sawing Used Lumber

WHEN sawing old lumber likely to contain hidden nails, damage to the saw teeth can be avoided if you use a heavy-duty or power hacksaw blade in a standard frame. A blade with 10 teeth per inch is about right; it cuts wood well and will walk through a nail as if it weren't there.—*Walter E. Burton, Akron, Ohio.*

Corks Help Check Gas Level

SINCE most small gas engines use white gas, it is difficult to see how much gas is left in the tank. However, several pieces of clean cork floating in the fuel will provide a visible reference point. They won't interfere with operation because the feed pipe is always below the surface. —*R. Hanscom, Elmhurst, Ill.*

Bring on your most luxurious outboard cruisers . . . put a weekend load aboard! The Mark 78A planes 'em! Hitch on half-a-dozen skiers. The Mark 78A lifts 'em from deep-water starts!

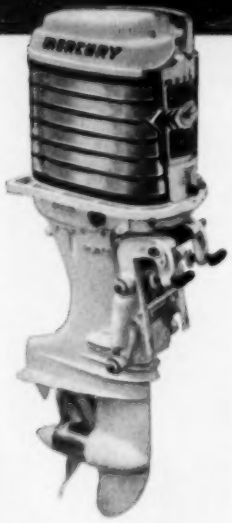
MERCURY

THE MOST POWERFUL NAME IN OUTBOARD PLEASURE!

Photographed at Florida's Silver Springs

MARK 78A
70 hp, 6-in-line

World's Most Powerful Family Outboard. Exclusive HYDRAULIC DYNA-SHOCK ABSORBERS plus Safety-Tilt Switch protect boat, motor and passengers — restrain motor kick-up from underwater obstacles . . . return motor to water to avoid loss of steering. Exclusive FIXED-JET CARBURETORS eliminate *all* adjustments except for idle, as on your car. Truly the outboard of the year and of all time!



Unequalled thrust power for more fun per dollar, more work per dollar — yet so slim, trim and light that it's a perfect partner for speedy runabouts! Mercury's exclusive 6-in-line design gives you the *most* horsepower per pound, per cubic inch, per dollar; the most miles per gallon — the most propeller thrust per horsepower. *Certified* 50,000-mile dependability, 100+ mph durability! Exclusive single-lever one-hand control combines electric starting, choke, forward, reverse and throttle . . . shifts far faster, far more safely than old-fashioned gear shifts — without jolt or clashing gear noise — and bronze or aluminum propellers may be used! The engine that stays young for years is yours with Mercury. See your dealer for the rest of the story and a *free* demonstration ride!

Write for FREE Catalog. Address Dept. PS-2

THE WORLD RECORD LINE FOR '59 — 6 to 70 hp!

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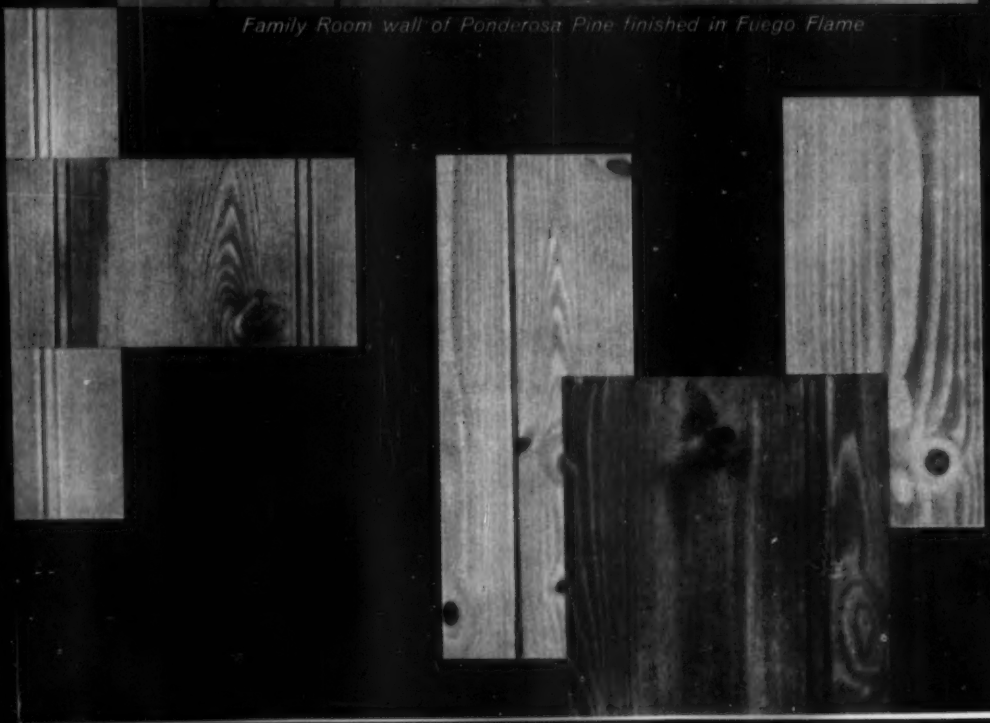
Look what you can do with

Western Pine Region woods*

Family Room wall of Ponderosa Pine finished in Fuego Flame



Finish them any color...but let the natural beauty and grain show through

Here's *decorating news* . . . the warmth and beauty of natural wood paneling comes alive in modern color . . . for any room in your home. A specially prepared book (described below) gives full details.

You can create colors and effects similar to those on the opposite page . . . and many more. Here's how: select your paneling of Western Pine Region woods. Choose from a variety of patterns, in ten distinctive softwood species, in clear or knotty grades.

- Careful *sanding* is important. Sand first with medium-coarse paper to remove any rough imperfections. Progress to 3/0 sandpaper for fine surfacing.
- In kitchens, bathrooms or basements guard against moisture. Apply *commercial sealer* to all sides, edges and ends of paneling.
- *Color* can be applied two ways. Brand name, ready-made stains in bright or pastel shades are easily applied, and available everywhere. To create your *own* shades, mix oil-base paint and mineral thinner, or "colors-in-oil" and mineral thinner. Brush onto the paneling liberally. Then rub off with a soft cloth. Before proceeding, always test your color on samples of the exact wood being treated.
- To *highlight knots and grain*, rub over the stain with fine steel wool until the desired effect is achieved.
- An ideal *finish coat* is lacquer-sealer over the stain, rubbed with 6/0 sandpaper. Follow with a minimum of two coats of clear varnish or shellac rubbed with 3/0 steel wool when completely dry. Or . . . a simple paste wax may be substituted for the above.

For traditional or contemporary decorating, a wide range of textures can be attained through different surface treatments of Western Pine Region woods. They may be purchased ready-planed to a smooth working surface, or "rough sawn." They can be dimpled with a ball peen hammer, striated with a stiff wire brush, or sandblasted for a driftwood texture.

Western Pine Region woods make any woodworking job a pleasure. Due to their even texture and soft grain, they take any paint, stain or surface treatment with ease, and are easily worked with hand or power tools. Western Pine Region woods have a reputation for precise manufacture, quality seasoning and careful grading.

For your next remodeling job, workshop project or building program . . . choose versatile Western Pine Region woods. Your retail lumberman is the man to see. He will be pleased to talk to you about them. And remember . . . for more details, clip the coupon below.

Look for this WPA mark on well-manufactured and carefully graded lumber

*IDAHO WHITE PINE
PONDEROSA PINE
SUGAR PINE
WHITE FIR
INCENSE CEDAR
DOUGLAS FIR
LARCH
RED CEDAR
LODGEPOLE PINE
ENGELMANN SPRUCE

Western Pine Association

Dept. 403L, Yeon Bldg., Portland 4, Oregon

☐ Please send me a free copy of "Nature Makes News" which tells more about color-finishing Western Pine Region woods.

☐ Include "101 Home Ideas" featuring many decorating and remodeling tips using Western Pine Region woods.

Name_____

Address_____

City_____ State_____

Short Cuts and Tips

Portable Acetylene Welding Wagon

WELDING equipment in our shop must be portable, so we built this cart from a standard 800-lb. 16"-by-30"-by-36" steel truck.

Holes were cut in the top tray to take the oxygen and acetylene tanks, the former resting on the bottom shelf and the latter, at convenient working height, on a 6" sheet-metal drum.

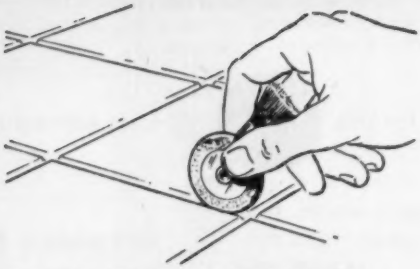
Containers for 36" brazing and welding rods were made from 1½" thin-wall conduit also fitted through holes in the top. Four troughs at an angle in one side hold 18" welding rods.

All containers are removable for cleaning and refilling, and there is room on the shelves for accessories. —*Wayne Judy, International Falls, Minn.*

Magnetized Shop "Broom"

A MAGNET held in an envelope or paper sack and swept over your shop floor or workbench will provide an easy way to pick up iron chips and filings. Afterwards hold it over a container, remove the magnet and, presto—the chips drop off.

It will also prove handy for recovering brads or pins without picking up dirt—*Bil Toman, Palatine, Ill.*



Erasing Stains in Tile Grout

I USE an ordinary typewriter eraser to clean stains and dirt in the recessed area of grout between bathroom tiles.

No cleaning agent is necessary since the pumice in the eraser acts as scouring powder. I scrub with the eraser, using plenty of warm water to flush off dirt, then brush the crevices with the eraser brush.—*Carl L. Beddig, Oakland, Cal.*

New Du Pont Oil Stains in Vibrant Colors!

Here's the big decorating news of the year. Oil stains in *color* . . . to give a modern brightness, yet let the natural beauty and grain of the wood show through. The latest thing for wood furniture, wood panel walls, wood trim and floors. Du Pont Satin-Sheen Oil Stains come ready mixed in all natural wood effects . . . or you can create almost any color you choose by mixing Du Pont Custom Tinting Colors with Du Pont Satin-Sheen Platinum Oil Stain. Never before have you had such a wealth of unusual color effects to enhance the beauty of any wood surface. Full instructions for mixing and applying are right on the can!

A Satin-Sheen Varnish That Resists Marring!

"Dulux" Satin-Sheen Varnish gives furniture and interior woodwork a satin-smooth hand-rubbed effect . . . brings out the beauty of the grain. Odorless; minimizes surface defects; wears and wears. Unexcelled for mar and water resistance.

Buy the paint that's worth the work! Your time is too valuable to risk on "bargain" paints. When you buy Du Pont Paint, you know that the beauty is going to last. Du Pont Paint Chemistry assures you of that. See your Du Pont Paint Dealer . . . you'll find him listed in the Yellow Pages.

DU PONT

Better Things for Better Living
. . . through Chemistry

Short Cuts and Tips

Chain-Link Picture Hanger

A TINY hanger, just right for mounting a small wood plaque or picture, can be made by flattening out one link of a non-kinking window chain. You simply screw one end to the plaque and bend the other back slightly so it will slip over a nail or hook.—*Frank A. Javor, Newark, N.J.*

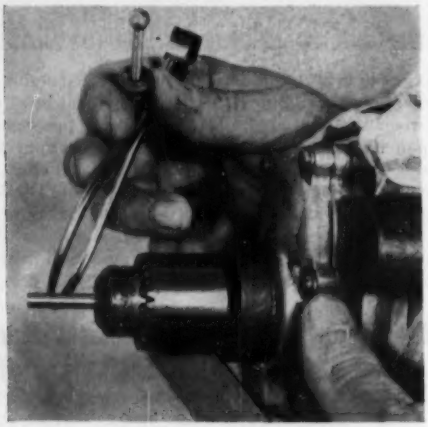
Measuring Photo Solutions

IF YOU use a developing tank for several sizes of film, a properly marked wide-mouth jar will eliminate guessing.

Adjust the tank for one size and cover the reel with water. Pour into the jar and mark. Then repeat for each required size.—*Peter Barna, Wilmington, Cal.*

Clamping Small Parts

SETTING a clamp in a vise so the jaws can be moved will provide you with a good method of holding small parts at convenient working height. The smooth jaws of the clamp will not mar a finish as a vise might.—*R. J. Phillips, Uncasville, Conn.*



Electric Drill Serves as Lathe

BY PADDING my electric hand drill with cloth and mounting it in a vise, I frequently use it as a small lathe. I find it excellent for turning down to size pins and similar fittings with a file or emery paper.—*C. C. Cooley, Detroit.*

Ever wanted to design your own car? Chevrolet lets you come awfully close—with a choice of nine engines, five transmissions, two suspension systems, regular or Positraction rear axles, special cams, solid or hydraulic valve lifters, two air conditioning systems, even Fuel Injection. You name it, chances are Chevy has it. Here's an example of what we mean:

"I 'built' my Chevy to handle like a sports car . . . for five!"

"Take a young architect (that's me) with a Corvette appetite, a one-car budget and a family of wife, three kids and a puppy, and you've got *frustration.*

"That is, you did—until Chevy came out with that terrific four-speed floor-shift gearbox.* The minute I heard that, I knew Chevy had given me the makings of a *family* sports car that would be the greatest!

"Here's how I 'designed' the sweetest handling five-seater that ever came down the pike: First, an Impala two-door sport coupe. Then the 290-h.p. Fuel Injection V8* and, buttoned on right behind it, that *great* four-speed box. (That's the Corvette transmission, you know, with synchro on all *four* gears and that solid, direct floor shift.) The driveline ends up with Chevy's limited-slip Positraction* rear axle to give me real glued-to-the-road traction on gravel, mud or whatever.

"Seat belts, of course, and those optional nylon tires. But I wouldn't add a thing to the genuine road car feeling of Chevy's Full Coil suspension and Ball-Race steering. I've let a lot of my sports car friends drive the Impala and you ought to see the look on their faces after a couple of blocks. Man, I never thought a sedan could feel like *this!*"

It's a fact; here's a car you really can tailor to your measure. Why don't you sit down now and make an outline of what your "ideal" car would be like—we'll bet there's a Chevy that fits the specifications like a glove! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

CHEVROLET

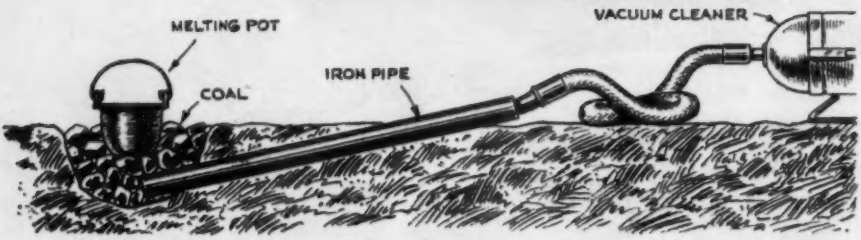
**Optional at extra cost.*

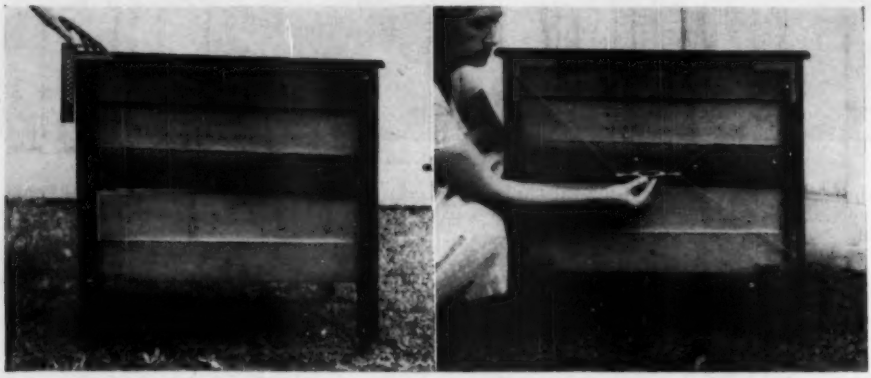
Short Cuts and Tips

Homemade Forge for Melting Metals

A VACUUM cleaner and an iron pipe will provide you with a forge in this age of no blacksmith shops.

Dig a hole to take your fire pot, lay the pipe down a sloping side trench and build a coal fire in the pit. The vacuum-exhaust end provides a blower.—*James C. Morris, Hobart, Ind.*

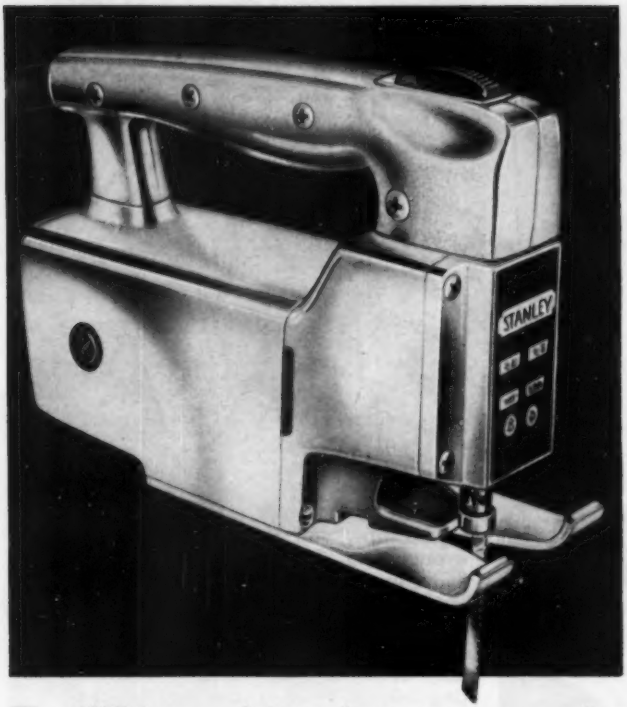


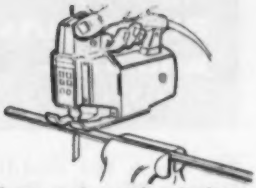


How to Take the Wobble Out of Old Furniture

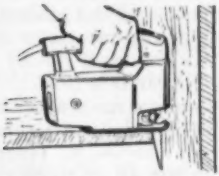
SOMETIMES, when drawers stick in an old chest, you can plane all day without curing the trouble. That's because the wobbly piece has worked out of alignment.

A quick expedient—without dismantling and regluing—is to wire the back until it is again as tight as a drum. Install a turnbuckle between two wires from top to bottom corners, and tighten until the wires zing. The best method is to use a projecting screw in each of four corner braces.—*Kenneth Murray, Colon, Mich.*

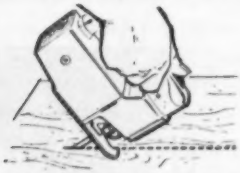




Full power for cutting laminates, plastics, 2" wood—even ½" steel bar!



Exclusive feature that lets you cut flush—right up to a vertical surface.



Starts own hole in surface of stock. Cuts fast, blows chips clear of cut.

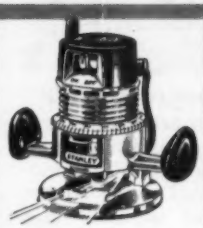
The ONE heavy-duty sabre saw you can buy for as little as $54.50

Compare the prices of other heavy-duty sabre saws: $135, $138, $99.50! The lowest priced, heavy-duty, industrial-rated sabre saw you can buy is Stanley's H75 saw, shown above.

Like the top-priced saws, the H75 cuts 2" wood; has completely balanced anti-vibration construction; produces over 3000 long strokes per minute; is rated at 2.5 amps.

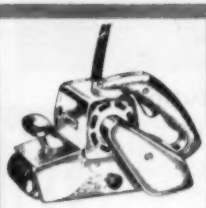
But *un*like these costly sabre saws, only Stanley's H75 permits flush cutting; is lightweight and costs as little as $54.50. See it before you buy *any* sabre saw. For free catalog write: Stanley Electric Tools, Div. of The Stanley Works, 632 Myrtle St., New Britain, Conn.

STANLEY *Electric tools built for the pro, priced for the amateur*

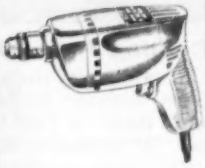


Heavy-duty ⅞ HP router with spotlight. A professional tool at $62.50.

Stanley's rugged orbital sander for super-fine finishes costs only $54.95.



Powerful belt sander rough sands and finishes wood, metal: $89.95.



Full 3-amp ¼" drill. The most powerful drill you can buy for $24.95.

Short Cuts and Tips

Tie Rack for Holding Dozen Clip-On Bows

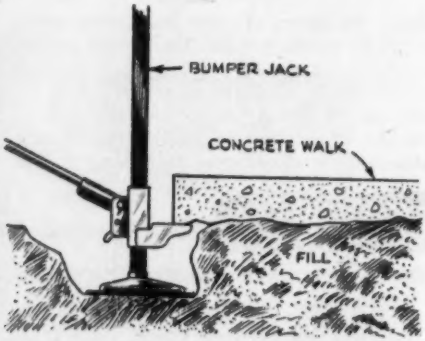
I HAVE found that a Venetian-blind slat screwed to the back of my closet door makes an ideal holder for my clip-on bow ties.

Two screws put through holes bored in one side of the slat fasten it. There is room for 12 or more clips on the slat.—*Leroy M. Beckett, Manchester, Conn.*

Cooling Photo Solutions

A QUICK way to cool photographic solutions without further diluting them is with three or four ice cubes floated on top in a plastic bag. Convection currents continually carry the warmest part of the solution past the cooling bag. It works almost as fast as putting the ice cubes directly in the solution.—*Noble D. Carlson, Willoughby, Ohio.*

▶▶▶WHEN you can't get a good fit with crutch tips, you can keep the legs of wrought-iron furniture from scratching and gouging the floor by wrapping with electrician's rubber tape. File down sharp edges and stretch and mold the tape about the base as you apply it. If carefully done, the finished tip can't be distinguished from one manufactured for the job.—*John Granger, Wood-Ridge, N.J.*



Raising Sunken Concrete Walk

FACED with raising a section of concrete walk that had sunk, and having no wrecking bars, I used a pair of automobile bumper jacks instead. I placed the jacks under the slab at opposite sides and raised it high enough to provide working space. Then I added fill and gravel under the slab and lowered it into position.—*M. Bermann, Skokie, Ill.*

HOW AMERICA'S NUMBER ONE CARBURETOR TRAINS AN ARMY OF SERVICE EXPERTS!

Wherever you go, you'll find Rochester-GM Carburetor specialists who can quickly and accurately diagnose and correct trouble to save you time and money.

Each month a trained army of Rochester-GM Carburetor specialists graduate from General Motors Training Centers and Rochester-GM Carburetor Field Schools all over the country. This training in carburetor repair and adjustment makes them qualified to maintain Rochester-GM Carburetors at peak efficiency. There's a Rochester-GM specialist in your neighborhood. Look him up for new-car performance. Or, if you are a mechanic interested in receiving Rochester-GM Carburetor training in your area *free of charge*, write to: Rochester Products Division of General Motors, Rochester, New York.

Qualified instructors with vast automotive experience train mechanics in every phase of carburetion, in the fastest, surest way to service Rochester-GM Carburetors.

Up-to-the-minute bulletins keep these specialists fully qualified at all times to assure the most efficient operation of your Rochester-GM Carburetor.

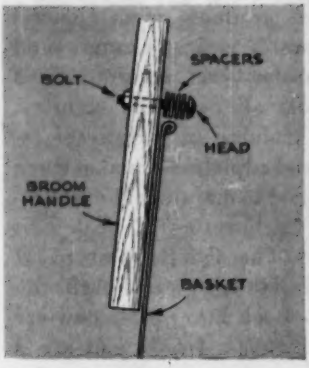
General Motors Training Centers offer mechanics professional methods of maintaining carburetors at peak efficiency. Night Field Schools are arranged for those unable to attend day classes.

GM
GENERAL MOTORS

America's number one original equipment carburetors

ROCHESTER CARBURETORS

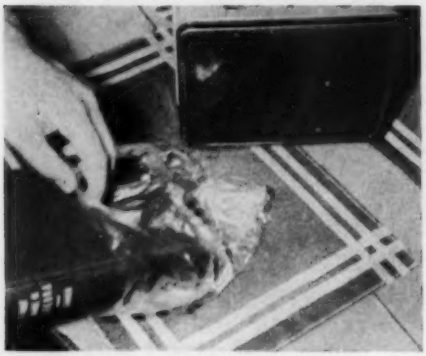
Short Cuts and Tips



Wastebasket Table Is Handy Mount for Photo Trimmer

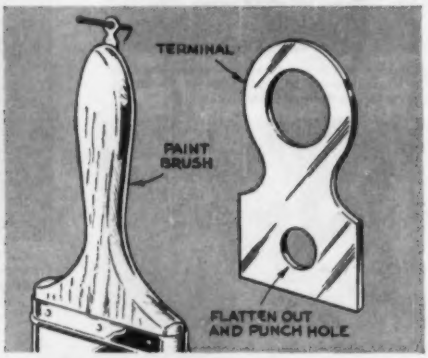
THIS three-legged table has a metal wastepaper basket for a base. I built it as a convenient place to keep—and use—a trimmer for photographic paper.

It is made of broom handles set snugly in holes bored in wood blocks and has a plywood top. First I sawed the handles to length, squaring both ends. Then I drilled each leg 3″ from the bottom end to take a long bolt and spacers that hold them on the rim of the container. After that I simply glued the legs into the blocks and glued the blocks to the top.—*Glen F. Stillwell, Manhattan Beach, Cal.*



Plastic Bags Protect Books

PACK several plastic food bags in your child's lunchbox when he starts for school each day. They take little room and yet, in case of rain, can be quickly whisked out to make waterproof covers for his schoolbooks. Be sure they are rinsed clean and thoroughly dried before packing them.—*Richard M. Wood, Worcester, Mass.*



Hanger for Paintbrush Handle

SOME paintbrushes have no handle holes for hanging between jobs. You can offset this by using a small terminal made for soldering to electric wire. Flatten the end, punch a hole in the flattened part, and tack to the brush. It swivels out of the way when you are using the brush.—*William B. Eagan, Floyds Knobs, Ind.*

Paneling in random-plank style is 4' x 8' Weldwood Prefinished Walnut V-Plank®.

You can panel a room like this in a weekend . . .

Weldwood prefinished wood panels give you ready-made beauty—save time and fuss—as little as $75 for a 12' x 8' wall.

You can panel a lovely room like this in a weekend even with no previous experience. Weldwood *prefinished* wood panels come in a wide range of choice woods, prefinished and ready to brighten your home. Weldwood's exclusive 14-step lacquer process produces a true fine furniture finish so luxurious you can actually feel the difference. Saves you time and fuss in installing, too. What's more, it's a stain- and smear-resistant finish that's easy to keep clean through the years.

If you prefer, you can buy Weldwood Paneling *unfinished* at lower cost. Use Weldwood Satinlac® Lightener as a first coat to prevent the darkening or "wet" look usual when new wood is finished. And for a lustrous, *hand-rubbed* look with half the effort use Weldwood Satinlac®. Protects wood and brings out its beauty. See the more than 70 types of finishes of Weldwood paneling at your Weldwood lumber dealer's or at any of our 115 offices in U. S. and Canada.

No nail holes mar your handsome wood panels when you use Weldwood Contact Cement. Gives a permanent bond to furring strips. No clamping is necessary.

WELDWOOD® PANELING

AND OTHER WELDWOOD PRODUCTS FOR HOME AND INDUSTRY.

SEND THIS COUPON TO GET DETAILS!

NEW PREFINISHED PANELING BOOK PS 2-59
United States Plywood Corporation
Box 61, New York 46, N. Y.

Please send me a copy of the new full-color folder, "Presenting Weldwood Prefinished Paneling for Fine Interiors," which beautifully illustrates in color the 14 Weldwood prefinished woods and gives complete installation details. I enclose 10¢.

Name.....

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City.....**State**.....

Short Cuts and Tips

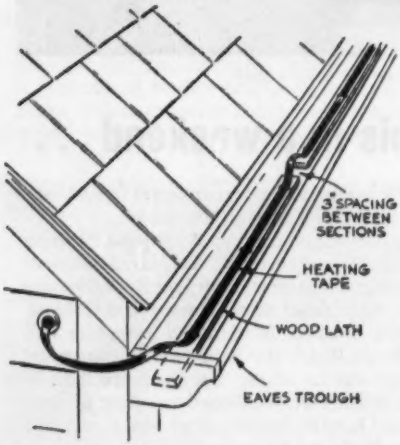
Doorside Rack Holds Needed Tools

FREQUENTLY used tools will always be handy if you keep them mounted on a simple rack on the inside of a closet or basement door.

This one consists of a hardboard panel, tool clips and tin cans to hold nails.

Arrange the tools on the board and mark their positions. Remove the tools and screw on the clips and cans. Then hang the panel with hooks and eyes.—*R. M. Woodbury, Natick, Mass.*

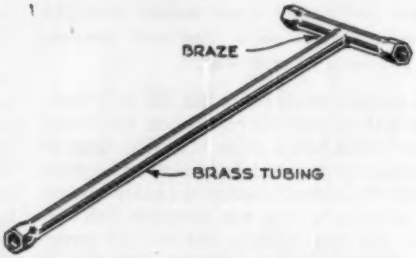
▶▶▶THE identification labels for small-parts containers of glass or transparent plastic stay clean if glued to the inside. Cut masking tape to desired size and ink the legends on the adhesive back. —*Nathan S. Steigman, Howard Beach, N.Y.*



Cold-Weather Tip for Gutters

I INSTALLED a 30′ length of heating tape in the eaves trough on my home two years ago. This winter I increased its efficiency by stapling it to several 3′ pieces of wood lath before reinserting it in the gutter. The wood holds the heat for a longer period than the metal gutter where it was quickly dissipated.

Result: a larger heating surface that melts ice much faster. In the spring the lath is easily folded and stored.—*Wallace M. Genthner, Averill Park, N.Y.*



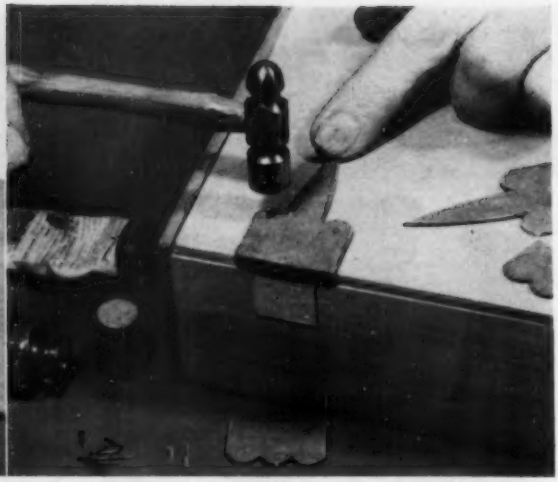
Tiny Wrench for Model Makers

IF YOU make models and need an undersize wrench for assembling small bolts and nuts, you can make one from scrap pieces of brass tubing, using a set of Allen wrenches for dies.

Force the tubing over the head of a wrench and form the hexagon by hammering the sides. If you wish, you can make a wrench for three sizes by brazing two pieces of tubing to make a T and forming a different size socket in each opening. —*John M. Minor, Torrance, Cal.*

NEW!
THE DRILL THAT DRIVES A WORKSHOP
Patterned after Millers Falls famous "888" Power Unit, this versatile new ¼" electric drill direct-drives a wide line of rugged, quick-change attachments – many of them the same as are used with the "888". It's truly a mighty mite with full 2.7 amp. motor and 2250 RPM gearing for high torque. Ask your dealer to let you see it soon. It's the dollar-saving way to start a 14-tool power workshop with maximum performance and *real economy.*
2.7 amp.
Portable Saw Attachment $13.50
Orbital Sander Attachment $15.50
Portable Jig Saw Attachment $12.50
Bench Sander Attachment $9.95
7-to-1 Speed Reducer $13.50
Drill Press Stand $18.95
Drill Press Vise $5.95
Jig Saw Table $1.95
Floor Polisher Attachment $29.95
Bench Grinder Attachment $7.95
Bench Stand $1.95
Hedge Trimmer Attachment $12.95
No. 1114 Power Drill $22.95
MILLERS FALLS TOOLS
SINCE 1868
Write for free literature
MILLERS FALLS COMPANY
Dept. PS-27, Greenfield, Mass.

Short Cuts and Tips

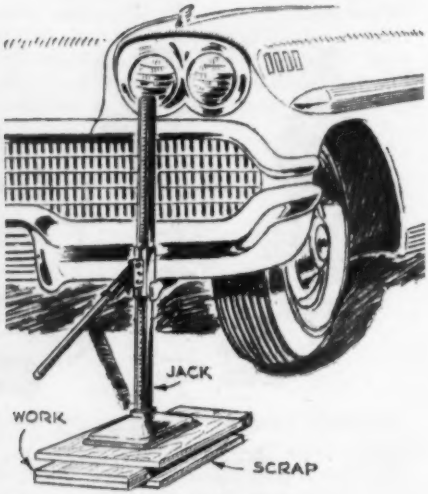


Easily Made Fancy Hinges

CARDBOARD, fiber and tin-can stock make effective decorative hinges for cabinets, chests, boxes and albums. You first cement on strips of cotton tape that make the actual hinges. Then cut leaves to shape, glue the halves over the tape and put in escutcheon pins. Bevel abutting edges so lids won't bind; groove the underside of cardboard before bending.—*Walter E. Burton, Akron, Ohio.*

Blunting Nails to Avoid Splitting

IF STANDARD nails have a tendency to split the wood into which you drive them, try squaring the ends. It's easier—and just as good—to do this with a hammer instead of filing or cutting off the points, and you can control the degree of bluntness.—*K. C. Murphy, Detroit.*



Emergency Glue Clamp

AN AUTOMOBILE jack makes a handy clamp in an emergency. Place the work between two pieces of scrap wood under the jack's base; then pump the lever until the jack is engaged. Tremendous pressure can be applied by using the car's weight. —*John A. Comstock, Wellsboro, Pa.*

NOW PLYMOUTH OFFERS THE BIGGEST V-8 IN ITS CLASS—AT A REDUCED PRICE!

Meet the New Golden Commando 395—bigger and quicker than its 1958 counterpart—yet lower in price! You can get this giant 361-cubic-inch engine with stick shift or new water-cooled TorqueFlite Drive.

Best news about the New Golden Commando 395 is, of course, that lower price. But there's plenty more to gladden your heart, too. For one thing, this special V-8 is now available even in the lowest priced Savoy Sedans and in popular Plymouth wagons, too. For another, there's the astonishing new smoothness and cat-quickness of this engine. For still another thing, it's got the highest torque per cubic inch of any engine built by Chrysler – 395 ft. lbs. at 3000 RPM!

New Golden Commando 395 V-8 engine

Bore of the New Golden Commando 395 is 4.12 inches; stroke 3.38 inches; compression ratio 10 to 1. Maximum horsepower is 305 at 4600 RPM. There's a special high-performance camshaft, 4-barrel carburetor, low-restriction dual exhaust system, positive pressure lubrication system and all the other features you expect in a specially-engineered power plant from Chrysler Corporation. See your Plymouth dealer and test-drive the New Golden Commando 395 in one of his sleek, sure-footed new Plymouth models soon!

TODAY'S BEST BUY . . . TOMORROW'S BEST TRADE **Plymouth**

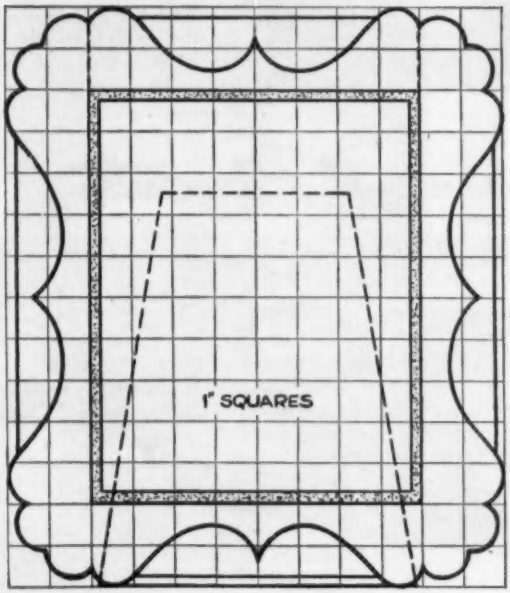
Short Cuts and Tips

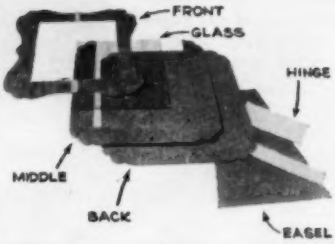
Easel Frame Made of Hardboard

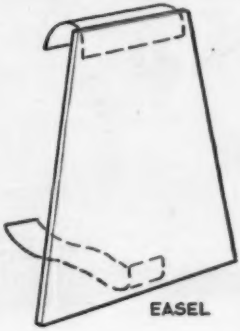
You can make an unusual desk picture frame of 1/8" tempered hardboard, a facing of 1/4" decorative hardboard, and glass. The stand is attached with a leather or cloth hinge.

The frame has three glued-up pieces: a solid back, open-top middle, and front with a jigsawed rectangular opening.

For a handsome two-tone effect, the middle piece and the inside edge of the face, or 1/4" border, should be painted before gluing. Finish applied to the face should be wiped before drying to accentuate grain.—*F. L. Bruce, Chicago.*







New Sea-Horse V-50—so quiet at full throttle you can enjoy your radio or conversation!

Secrets of the soft-spoken Sea-Horse!

In recent years, the biggest news in outboard boating has been strictly "hush-hush"! Johnson has been keeping things quiet—its motors, that is. Though more powerful, these beautiful outboards are now made quieter than ever before. Every Sea-Horse for '59 includes four special features to eliminate annoying noise.

THE PERFECT MUFFLER

No gasoline engine could operate without exhaust. Johnson motors use the ideal exhaust muffler—water! By discharging exhaust under the water, noise is reduced to a gentle, bubbling sound.

SPECIALLY DESIGNED GEARS

Johnson engineers did away with the whine of fast-turning gears by designing unique Spiral Bevel gears. Velvet-quiet when new, they stay quiet even after years of use.

VIBRATION CUSHIONING

Soft rubber mounts "float" the larger Sea-Horse motors within their housings. On smaller engines, a unique Johnson Suspension Drive separates the motor from the boat, dampening noise radiation.

SOUND-SEALING HOUSINGS

Any remaining sound from a Sea-Horse motor is tightly sealed inside the motor housing—right down to the water line. The new '59 fiberglas-reinforced plastic hoods with Johnson's exclusive Dynautical Design are particularly effective in this respect.

Also, sound frequency is controlled. This can make the difference between an annoying whine and a hearty engine purr. Johnson engineers use the most modern electronic instruments to track down sources of high-frequency sound and reduce them to comfortable levels.

No wonder Sea-Horse owners are pleased with the quietness of their outboards, whether they own a 3 or 50 hp model. Johnson is the only outboard motor ever to win an award for quietness from the National Noise Abatement Council. See for yourself how quiet a Sea-Horse can be. Your Johnson dealer is listed under "Outboard Motors" in the Yellow Pages.

Johnson *FIRST IN SALES FIRST IN DEPENDABILITY*

Short Cuts and Tips

Picnic Cover Has Many Uses

A PLASTIC tablecloth can be handy on a motor trip. Use it as a poncho in rain, a ground cover after a shower, and an extra blanket on a cold night.

Stretched taut, with the corners tied to stout stakes or to trees, it will shelter you from hot sun or a heavy rain at beach or lake.—*C. V. Mathis, Wildwood, N.J.*

Crumpled Plastic Dusts Discs

DUST can be lifted from the grooves of a record by holding a piece of plastic wrap close to, not on, the disc as it turns. Handling and crumpling the plastic generates static electricity to attract the dust. —*Murray Kent, Detroit.*

Rubber Bands Stop Hose Leak

WHEN a lawn hose has swollen from long use or from lying in the sun, it may not fit a coupling tightly. To keep the joint from leaking, snap rubber bands around the neck of the connector before inserting.—*K. L. Murtagh, Flint, Mich.*

Wire Keeps Soldering Iron Hot

BARE copper wire coiled around the tip of your soldering iron will keep it at peak efficiency when you lay it aside for a moment.

The wire will retain some of the heat that would otherwise be lost to the air.—*Karl MacMurray, Calumet, Mich.*

Two Nails Lock In a Cork

THERE'S always danger of spillage when you haul a corked bottle or can in the car, or store it on its side.

By running a couple of nails through the cork at angles, as shown, you can make sure that it won't pop out.—*Hugh Lineback, Stillwater, Okla.*

Now...choose your vocational training!

new "choose-it-yourself" training system guarantees CHOICE, not chance

Now you can pick the vocational training *you* like! Under the Army's new "CHOOSE-IT-YOURSELF" Vocational Training System, *you* choose your vocational training . . . and it's guaranteed *before* you enlist. Here's your opportunity to get valuable training and practical experience in the kind of work you *enjoy!*

Choose your vocational training from many interesting categories like these . . .

Radar & TV Repair	Military Police	Finance	Drafting & Cartography
Atomic Weapons	Printing	Construction	Metal Working
Surveying	Physical Medicine	Ballistic Missile Repair	Automotive Maintenance
Military Intelligence	Electronics	Combat Engineering	Machine Accounting

Here's how you "CHOOSE-IT-YOURSELF":

1. CHOOSE
. . . before enlistment!

Choose the vocational training *you* like from the categories currently available. Your Army recruiter will give you all information and advice you need.

2. QUALIFY
. . . before enlistment!

Take aptitude and physical examinations . . . to be eligible, you must have a qualifying aptitude score and meet minimum physical requirements for your choice.

3. KNOW
. . . before enlistment!

If you qualify, you *know* you'll *get* the vocational training you like! Your choice is written into your future Army record—guaranteed *before* you enlist.

CHOOSE, QUALIFY and KNOW . . . without the slightest obligation to enlist! You *get* the Army vocational training you like—guaranteed in writing—or you *don't enlist!* This week, ask your local Army recruiter for complete details about the new Army system which lets *you* do the choosing.

NEW "CHOOSE-IT-YOURSELF" VOCATIONAL TRAINING SYSTEM

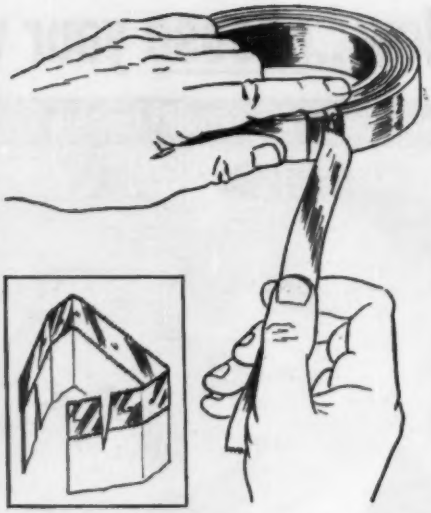
U.S. ARMY

Short Cuts and Tips

Film-Holder Cases

SAFE portage of sheet-film holders is assured on my long photo jaunts with these convenient cases. I made the peaked boxes of plywood, the twin hinged lids of aluminum, the covers of light canvas. The cases are 6″ wide by 8″ deep and 12″ long, and accommodate 14 holders or pack adapters between plywood dividers that can be removed for bulky items. Zipper pockets hold extra film rolls or packs. —*Francis S. Kalinowski, Syracuse, N.Y.*

▶▶▶TO RELIEVE condensation, open the basement windows a few hours each day. You can tell condensation from seepage in a damp basement with a small mirror kept against the wall. If the mirror fogs, it is condensation.—*J. E. Heft, Ionia, Mich.*



Sliding Tape-Roll Cutter

YOU can make a cutting edge for a roll of masking tape from the metal cutoff on a wax-paper dispenser package. Cut a length of the metal that will fit loosely around the roll and overlap on the inside. Slit the overlapping edges so they fit together neatly, bend to a rectangle and adjust it over the roll. Slide to cut any required length of tape, hold firmly, and tear off the tape against the serrations.—*Barbara Nicholson, Park Ridge, N.J.*

▶▶▶WORKING with various kinds of wood dough, I found it helpful for neat patching to wipe soap lightly on both sides of the putty knife. The plastic then won't stick and build up on the blade's surface. —*William B. Eagan, Floyds Knobs, Ind.*

Making a Small-Parts Washer

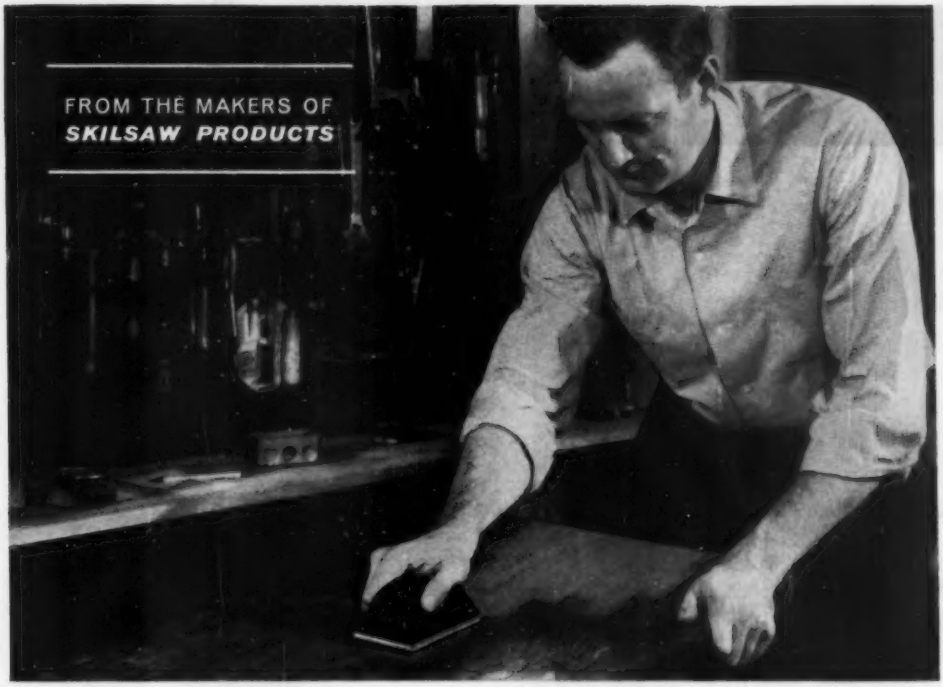
YOU can assemble an excellent washer for small parts by inserting an old aluminum percolator basket in a tin can.

Select a can so sized that the basket lip will rest on its upper edge. Pour in solvent until it rises to the desired level.—*Victor H. Lamoy, Upper Jay, N.Y.*

Self-Suspending Brush Holder

I'M kind of proud of my method of suspending a paintbrush in solvent.

When I open a can of the right size, I leave the top attached for about 1″. Then I bend it up, crease it in the middle and snip out a slot to take the brush handle.—*Frank Howell, Detroit, Mich.*



new PERMA-GRIT* hand sander cuts sanding time in half...

A wonderful, new workshop abrasive. Sands twice as fast as old-fashioned sandpaper. Can't be beat for removing old paint or enamel or for sanding wood, plastics, dry-wall, compositions.

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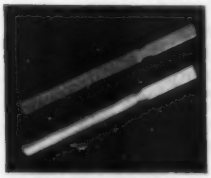

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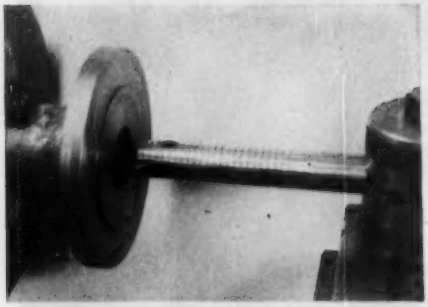
Short Cuts and Tips



Calibrated Boring Bar

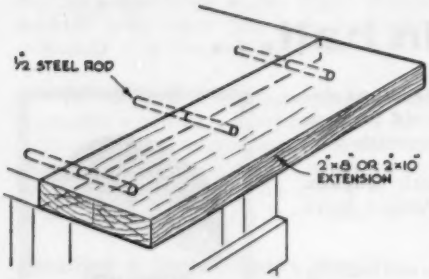
A SERIES of circumferential rings turned on a boring bar will help you to tell the depth of a cut. Space the divisions 1/4" apart and mark carefully with a punch. Then chuck the bar in the lathe and cut with a sharp-pointed tool.

Numbering each inch will give you a visual depth scale you can see at a glance. —*H. J. Gerber, Stillwater, Okla.*

Easy Way to Drive Posts

DRIVING in steel rods or fence posts is much easier if you use a hardwood wedge grooved to fit against the post. Clamp it on with chains set in notches in the block and held with stove bolts and wing nuts pushed through appropriate links.

Set the block at a comfortable height and strike it, not the post, with a sledge. —*M. Robert Beasley, Jackson, Mich.*

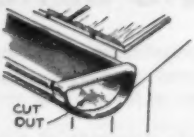


Removable Bench Extension

EVER find yourself without enough workbench surface on complicated jobs? You can add extra inches by putting on an extension leaf the length of the bench.

Drill 1/2" holes through the edge of a two-by-eight or two-by-ten and line them up with blind holes of the same diameter bored in the front edge of the bench. Slide 1/2"-diameter steel rods into the holes to hold the leaf in place. Pull the rods out to store the extension.—*William F. Eagan, Floyds Knob, Ind.*

How to Keep Dirt Out of Gutters

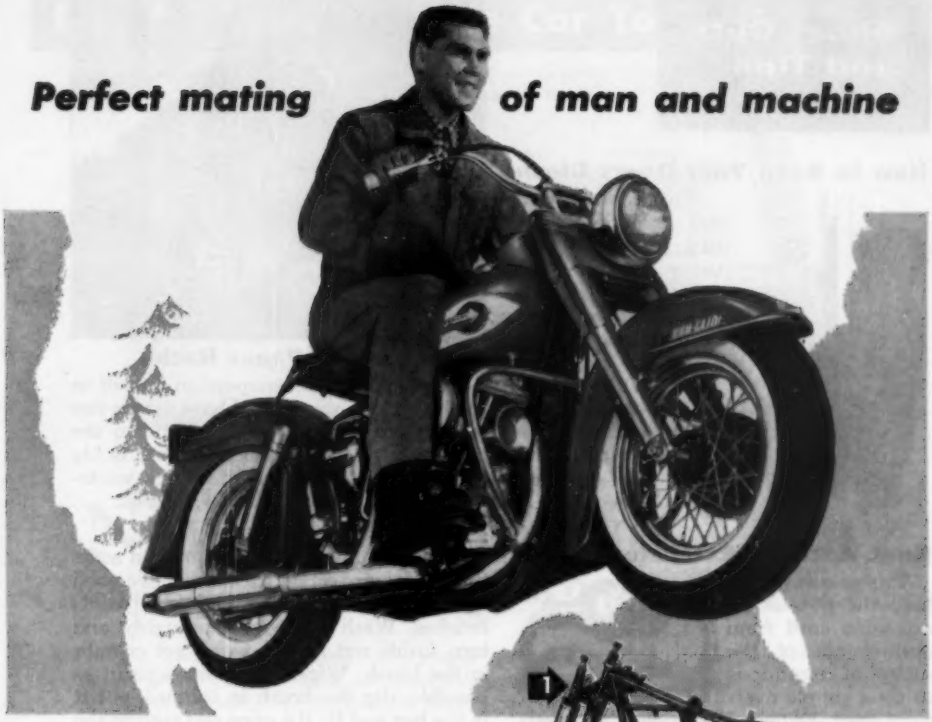


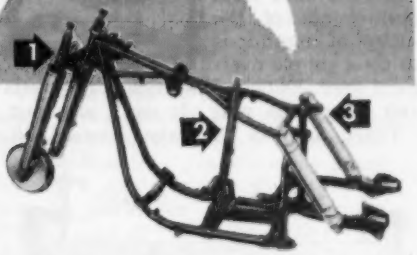
WHEN I found dust and mud accumulating in the ends of my gutters, I cut a section out of the blank ends. Now eddying air currents blow dust right through, and there is less danger of rust from collected water.—*Ernest E. Hurst, St. Louis.*

Clamps from Curling Clips

I FOUND a clip of the kind women use to curl their hair to be a useful clamp for cementing model parts. Bending the tips improves the grip. The clips come on 25-cent cards at variety stores.—*M. J. Killela, West Springfield, Mass.*

Perfect mating of man and machine





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2 **MIDDLE** — Spring-loaded seat post offers an extra measure of riding pleasure. Alone or riding double, springs give you a level ride at all times.

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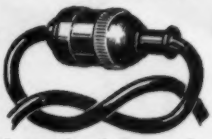
Short Cuts and Tips

How to Keep Your Doors Clean

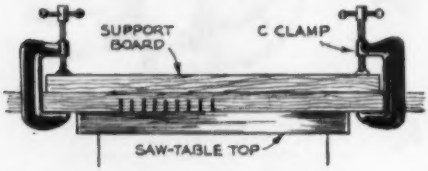
THE small fry *will* soil doors by shutting them without using the knob. A neighbor solved this problem in his house by gluing sandpaper along the edge.

The unlooked-for roughness proved to be effective—like an electric cattle fence.—*R. Mathiot, Lake Grove, Ore.*

Knot Anchors Extension Cords



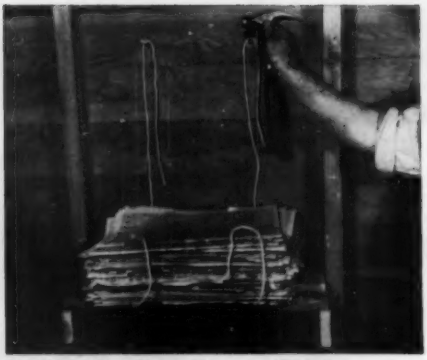
THE easiest way to keep the plug of an extension cord from pulling out of the socket of another is to tie a simple overhand knot. Entwine the ends of the cords and insert the plug. It can't slip out. —*T/Sgt. Kenneth R. Zinke, Rantoul, Ill.*



How to Kerf Long Boards

IF YOU use a circular saw to cut kerfs across the center of a long length of wood, the weight of the ends may damage them while still on the table. You can avoid this danger by stiffening the wood with a board clamped over the work area. —*Donald Spichuk, Brooklyn, N. Y.*

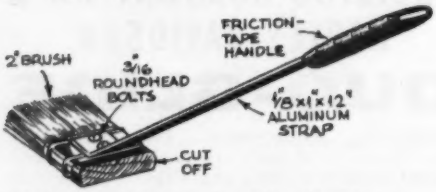
▶▶▶TO KEEP lime and fertilizers from rusting the underside of my lawn mower, I paint it with automobile undercoat. It resists chemicals better than ordinary paints.—*Harold Showacre, Annapolis, Md.*



Labor-Saving Paper Rack

I DISCARD old newspapers on a shelf in my basement over which I have driven two nails. Cords hang from the nails so the papers lie on them. When a stack is big enough, I tie it up neatly for the waste-paper pickup.—*C. C. Cooley, Detroit.*

▶▶▶THE aluminum liners found in some individual-size cereal packages make good between-jobs containers for small paintbrushes. Wash the bags thoroughly and turn inside out so you won't get crumbs in the brush. Wipe out as much paint as possible, dip the brush in thinner, put it in the bag and tie the open end around the handle. You can keep it pliable indefinitely.—*W. A. Joseph, Findlay, Ohio.*



Paintbrush for Inside Gutters

FACED with painting the inside of several gutters, I devised a brush that would reach the sides and bottom of the troughs and paint the supporting strips at top and bottom. It works equally well on both half-round and square gutters.

I drilled bolt holes through one end of a length of do-it-yourself aluminum and the ferrule of a sawed-off 2" brush. Next, I bent the end in a vise a little less than a right angle and bolted it to the brush. A handle made of friction tape at the other end provided a good grip.—*Reginald Dennis, Rockford, Ill.*

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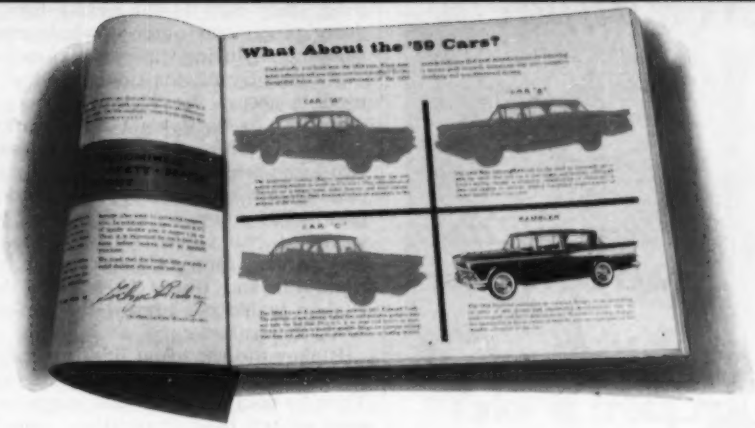

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Air-Lifting a Giant Missile
[*Continued from page 110*]

ning" they call it—for engine fires, runaway props and other unwholesome developments during these critical moments.

Apparently all the tie-downs had been used to secure the Thor, for there were none left to tie down Gachesa and me. We were sitting there on the floor like two loose peanuts in a giant beer can. In case of any sudden stoppage it wouldn't take a 704 computer to figure out where we'd go: two jagged holes in the front end of the thing. Gachesa took out a whodunit and began to read as Major Blakey taxied out toward the end of the 5,000-foot runway.

Blakey did the usual fiddling and jazzing with his engines, holding the brakes. Then he poured it on—that unmistakable solid all-out blast that jitters your back teeth—the full-power commitment to takeoff necessary on a short field with a heavy load. The plane began to move forward like a tired cow. The Douglas plant inched past on the right.

I looked up at the ceiling, waiting for the swaying buoyant feeling you get when the airplane leaves the ground. It didn't come. I looked out again. The Douglas plant was still there, moving slightly faster, and the engines were bellowing frantically. Too far down the field to stop.

Then, ponderously and painfully, the plane left the deck, and I took in a big relieved lungful of air—and held it, transfixed with horror—for all four engines, in that instant, lost their frantic snarl of power, and fell sickeningly, to a hoarse and feeble gasp. I shut my eyes tight. This, it seemed, was it . . .

No crash came. Somebody touched my arm. Sergeant Russell grinned broadly. "Nasty moment when we left the runway," he yelled in my ear. "Notice it?"

"The engines?" I yelled back.

"Yeah. Sounded like the things all quit. It was the gully. When we passed over it we lost the reflecting surface that was bouncing our sound back."

Passing the pipe. Flying with a Thor missile in the rear of a C-124 from California to Florida had its little inconveniences. We'd been assigned a flight altitude of 13,000 feet from Santa Monica to Carswell Air Force Base, in Texas, many many hours away, and in case you didn't know it, the air gets mighty thin

up there after awhile. It didn't bother me until I got up on my feet to take a look out of a window. Then I sat right down again, lovely dark smudges floating about in my brain. Russell came to the rescue with a walkaround oxygen bottle and mask. A dozen big drags on that pure O2 and I was back in business and passed the pipe to Gachesa.

"Hit it often," Russell advised us. "We've got plenty—and it can't hurt you."

About an hour out, the fuselage heaters quit. Gachesa and I wrapped ourselves in some blue Air Force blankets we found in a box, lay down on the deck and shivered, our breath white in the freezing barn of a place. A man wearing an oxygen mask with a steel container strapped to his back, Sergeant Gordon Thompson, the flight engineer, now wormed his way past the Thor with two heavy flight jackets belonging to the two loadmasters, Curry and Edge—and never have I been more grateful for an article of clothing.

Major Blakey made one of his usual old-pro grease jobs when he landed at Carswell, and most of us piled out onto the hardstand in the dark, working our arms and legs to get the kinks out. Gachesa, poor fellow, had to stay aboard the plane and watch his precious heating system. Sergeant Thompson had to stick around and bird-dog the refueling process. The rest of us drove to Operations —past an exciting line-up of brand-new B-58 Hustler bombers, the USAF's 1,500-m.p.h. pride and joy.

As is S.O.P. for a night refueling stop, we were there much longer than anybody expected (somebody had lost the key to the flagpole) but when we were finally back aboard the C-124, nobody was sweating a drop over the takeoff. Carswell is the first home of the monster B-36s, those 10-engined elephants that had to run half across Texas to get up speed to lift off. We had our wheels up and our flaps retracted before we hit midfield.

At the Cape. It was high noon of the following day before we landed at the Cape. I was completely bushed, even though all I'd done was lie there and wait. My legs were rubbery, my eyes felt as if they had sand in them, my ears rang unpleasantly from the blast of the big engines, and I had a robust case of heartburn from the sandwiches and coffee I'd

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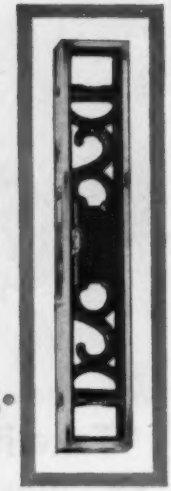

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Air-Lifting a Giant Missile

gulped back in Texas. Major Blakey, of course, had scarcely slept at all. Gachesa hadn't slept a bit (he wasn't permitted to take his eye off that bird for a moment). And the rest of the crew had been up and about 90 percent of the time.

Who greeted us when the C-124 rolled to a stop on the Cape Canaveral skid-strip and opened its mouth to disgorge the Thor? A cop! A very, very tough cop, packing a gun. Morris and I were both carrying cameras. We were in civilian clothes. This cop's eyes narrowed like Jack Webb's on a bad night, and he said, "Okay, you guys—what's going on here?"

Morris presented our orders, which, fortunately, spelled out our mission in detail. The cop looked at them doubtfully and demanded to see our personal identification. Having compared that with the orders, he said he was sorry, but these orders were only mimeographed. He'd have to take us into custody until he could confer with his boss and with Colonel Sid Spear, Information Service Officer on the Cape.

"Look," Morris said nervously, eyeing the efficient Cape ground crew, who had already begun to unload the Thor missile, "I got to get pictures of this unloading. It's part of the story, and—"

"Never mind that, Jack," the cop said. "Not until we find out who you are and whether you got any right to be here."

Colonel Spear, bless him, spoke the magic words on the telephone a few moments later, and our man became most friendly and cooperative. He permitted us to take our pictures. He then very kindly drove us to the gate of the Cape reservation where we could get a cab. "It wasn't that I had anything against you guys," he explained. "But I got to admit you shook me up a bit. Civilians walking out of a missile plane with cameras on! Well, it just never happened here before . . ."

Which is true. And before you've even read this piece, our big, white, 1,500-mile Thor will have been fired from the Cape—either over the South Atlantic range, as part of the USAF's continuing testing program to perfect this combat-ready missile further—or, like the recent heavyweight Atlas satellite, to circle the earth. Thinking back, I don't mind the sweat. It's probably as close as I'll ever get to the stars. END

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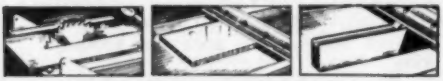

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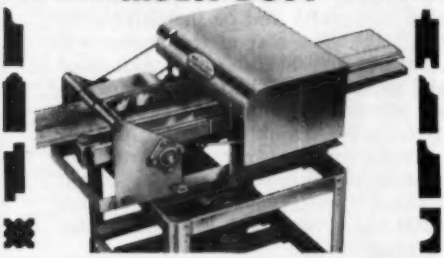

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The Snowplane: Blizzard on Skis

[*Continued from page 139*]

body with sheet-metal screws. For body covering, builders use sheet aluminum (also metal-screwed to the frame), regular aircraft cloth and dope, or fiber-glass. Plexiglas is universal for windshield and window areas.

Both the body shape and the door-opening mechanism offer further scope for ingenuity and craftsmanship. The simplest door is the standard, swing-out, car-door type. But some snowplaners have rigged top-opening deals like those on ultra-sports cars, or slide-backs as on airplanes.

The engine is bolted onto a cross-braced, welded-tubing support over the axle that connects the two rear skis. It must be high enough to give the prop adequate ground clearance. To compensate for forward thrust, the engine's weight is centered back of the axle.

How much do they cost? Before you get too enthusiastic about snowplanes, consider price tags. Naturally, there's a big variation, depending on how finished a ship you want, and whether you insist on features like fancy enclosed bodies and starters. You can pay from $1,500 to $2,500 for a typical two- to four-place snowplane. A really polished product like the CallAir, built in an aircraft plant by skilled mechanics, goes for around $4,000.

But if you build one yourself, you can pay full price for materials (exclusive of engine and prop) and be in business for under $500. The cost of the engine will depend on your location and your good—and someone else's bad—luck. Engines from wrecks—Lycomings, Continentals, and the older Franklins—often are fine for this purpose. Also, you may run into an engine with lapsed airworthiness that will shove a snowplane nicely for a tab of $100 up. Props cost $75 and up for an average ship.

For a long time now, aircraft engines and, of course, snowplanes have featured 12-volt-systems, twin mags and robust carburetors. They insure quick starts on 40-below mornings. Most of the currently built ships include starters. A typical snowplane instrument panel includes a tachometer, ammeter, oil-pressure gauge, and dual switches for the plural mags.

You're off. When starting, you switch on the mags, pull the choke, push the

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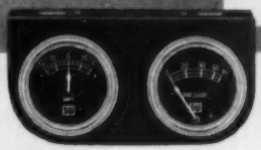

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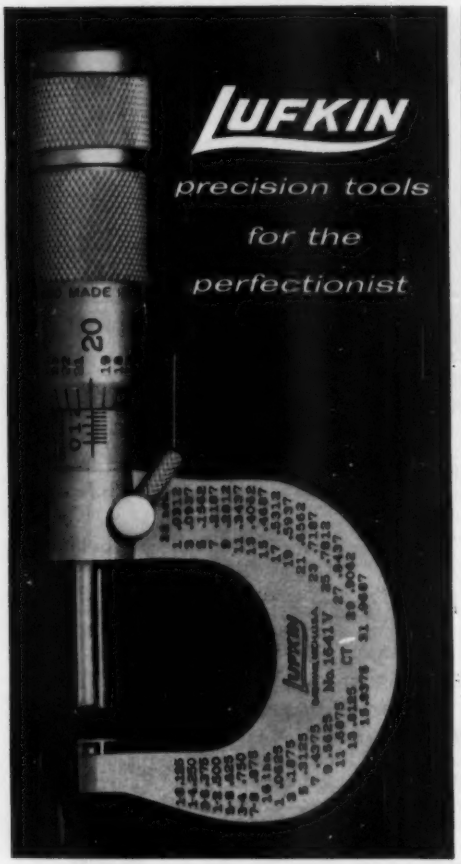

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starter, and find you're sitting in the middle of a life-sized windstorm. To take off, or break out of the settled snow that often sticks to runners, you use full throttle. After the plane is under way, you throttle back, aircraft style, to an operating speed that conserves the engine.

Mileage on these captivating contraptions varies with the size of the rig, engine, and conditions of snow, wind and topography. John Krause claims up to 35 m.p.g. when wind and snow are ideal. Jack Shepherd, another Jackson, Mont., snowplane builder feels that eight to 12 m.p.g. is a more realistic average.

Two types of steering gear are used. The first is the cable wound on a wheel, and connected through sheaves to the front ski structure. It is simple, effective and self-centering. For a more streamlined appearance, some builders have switched to a regular automotive, gear-type mechanism concealed in the hull.

Krause built the first planes for kicks, and used them profitably to scoot over the snow-drifted terrain to bag coyotes for both sport and bounty. Today, with the bounty off, Big Hole ranchers use their snowplanes to run alongside coyotes, and grab them (with a gloved hand) by their tails, and chuck them into burlap sacks. At the end of the chase they turn the live coyotes loose, forever after to scurry frantically for cover at the sound of a plane motor.

Lots of uses. Snowplanes are fine for ski-joring—towing skiers on exciting runs over the snowy fields and mountainscapes—and as mobile ski lifts. Every winter several families truck their ships down to snowbound Yellowstone Park and snowplane in to Old Faithful.

The strange ships have their practical uses, too. Ranchers use them to check on cattle, and to supply their back-country hands during the stretches when side roads disappear in the snow. Several youngsters get from ranch to road via snowplane in time for the school bus. At least one snowplane has been used to rush an appendicitis victim out from her snowbound ranch home just in time to save her life. And, as an unintended feature, the snowplane propwash has proved most effective in sucking flames away from a burning building—an important adjunct to rural firefighting. END

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Folded—it fits into your pocket or tool box—safety latch locks closed when not in use. Capacities: medium hard bolts in thread ⅜"; medium hard metals 5/16". Length closed: 10¾"; extended 15¾".

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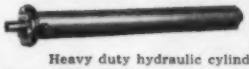

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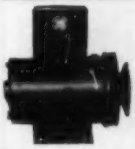

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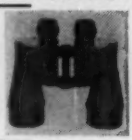

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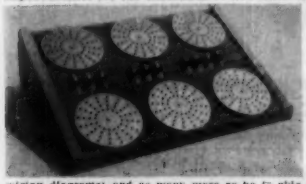

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What We Know About Skidding

[*Continued from page 148*]

heating the rubber. The greater the amount of heat developed, the greater the work done, and the greater the force needed. So rubber that heats up easily will require a very large force to keep it sliding. It would make a tire with high resistance to skidding.

Tabor proposes two ways to get around the very practical objection that such tires might wear out from overheating before you got a chance to try their skid resistance:

1. Use the quick-heating rubber only for the tread, slow-heating rubber elsewhere.

2. Make the tire narrow, to reduce the amount of rubber flexed (and the heat generated) in normal rolling. (Wheel diameter would have to be increased to provide enough contact with the road.)

Brakes that stop skids. General Motors, Ford and Bendix (a major brake supplier) are all known to be working on an anti-skid brake. None of them will talk about it. However, Dunlop Rubber Company, the British tire outfit, has also made one, and reported on it in detail. The idea is simple:

To skid, the wheel has to stop rolling. The anti-skid brake would never let that happen. The instant the wheel began to stop rolling, the brake would go off. As soon as the wheel began rolling again, the brake would go on again.

This system would make brake pressure go on and off very rapidly—automatic fanning, in effect. You would get maximum braking effort just short of locked wheels, and you could always steer.

British Government tests of the Dunlop "Maxaret" (on a Jaguar Mark VII equipped with double-pad disk brakes) proved this out. The car remained steerable, and stopping distances on wet pavement were reduced as much as 18 percent.

In this country, Prof. Archie Easton of the University of Wisconsin, who is chairman of the Safety Council's Committee on Winter Driving Hazards, tried out a similar brake last year on the ice of Pine Lake. This was a Finnish development, still experimental. It worked by releasing the rear brakes whenever the front wheels locked. Professor Easton told POPULAR SCIENCE:

"It showed up very well—even stop-

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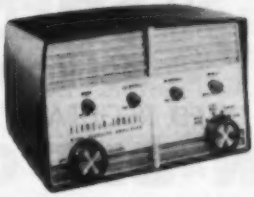

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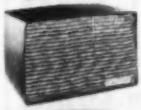

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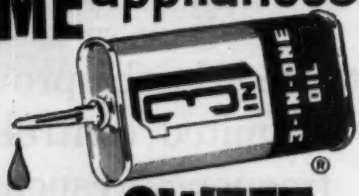

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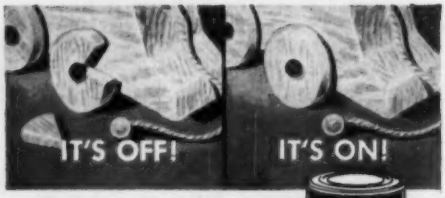

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ping a skid after one had started. But the trouble with all these things is that they're complicated and expensive."

Stickier roads. A quarter-century of research has shown how to make pavement do its part in preventing skids.

The ideal turns out to be a surface like sandpaper, made up of many very small and very sharp projections. The projections catch in rubber to give a tight grip. They have to be sharp so that they can break through the film of water that causes slipperiness. They have to be small and numerous to leave many little "valleys" that will drain skid-producing water away.

Both asphalt and concrete will make surfaces like that if mixed properly. One problem, though, is keeping that sandpaper roughness. The gravel and sand most often used as aggregate in U.S. highways is crushed limestone. Traffic quickly polishes limestone so smooth that it is slippery even when dry. (In Virginia, three counties that use limestone have twice as many skidding accidents as the other counties.) The remedies are usually expensive—natural sand or gravel aggregates or special thin coatings of sharp sand or aluminum-oxide abrasive mixed in plastic or asphalt-rubber latex.

The tricks that don't work. Like all folklore, the skid talk you hear at the grease rack is half truth, half fancy. Scientists have checked out both kinds. Some ancient and honorable skid preventives that have been disproved:

- Soft tires. Recommended pressure or *higher* shortens stopping distance and improves cornering on glare ice. Lower pressure (by seven to nine pounds) does help you start from a standstill.
- Manual transmission. In a Safety Council test, the automatic hydraulic transmission provided 30 percent more pull. (A limited-slip differential definitely helps.)
- Anti-skid gimmicks. The Safety Council tested one: a 50-pound weight centered inside a tube by springs and mounted across the back of the car. It was supposed to prevent sideslip. It didn't.

There are other ideas that don't work, but fortunately, still more that do. And new ones are coming up as scientists spur research into this driving hazard. END

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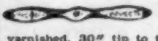
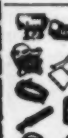
*Same as above with 10 in. x 13 in. drawing board—**$9.95** ppd.



WOOD PROPELLER Genuine rock maple radio drone "prop." perfect for den, trophy room, boy's room. Smooth, highly varnished, 30" tip to tip. Clock, barometer or photo can be inserted easily into center (mounting holes provided). Can use to operate ice sleds, etc. Approx. GOVT. COST $57. NEW. **$4.95** ppd.

"BIG 12" ARC WELDING & BATTERY CHARGING KIT With Deluxe Accessories consisting of one R1 300 Amp Gen., 30' welding cable, welder's adjustable helmet electrode holder, 300 AMP ammeter, 300 AMP shunt, Rheostat, Giant Toggle Switch, 300 AMP reactor coil arc Stabilizer, Voltage Reg., Reverse Current relay, 1 pr. heavy duty welder's gloves. All units guaranteed pretested. Approx. GOVT. COST $750. Most items new—all perfect. **$49.50. *400 AMP Gen. with above accessories—$64.50.**



"SUPER 9" 200 AMP WELDING KIT With Deluxe accessories consisting of one 200 AMP Gen., adjustable helmet, electrode holder, 30' welding cable, rheostat, giant toggle switch, voltmeter, voltage reg., 1 pr. heavy-duty welder's gloves. All units guaranteed pre-tested. Approx. GOVT. COST $500. Most items new—all perfect. **$26.00.**

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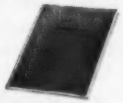

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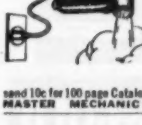

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A Close Look at the Simca
[*Continued from page 156*]

44.4:1 rear axle, I found myself accelerating on moderate grades. The top three gears are synchronized.

Still, I have some complaints about the gearshift; its throws are short and precise but the action is so stiff you have to work at it. The neutral position is deceptive; shaking the lever up and down is no assurance you're not in gear—the stick wiggles even when it is. Most drivers find it hard to get into reverse at first. It's down under fourth, impossible to gauge by eye.

Pros and cons. Front head and leg room are only average, or tight for tall drivers. But I'll give the reclining seat backs (standard in the Super De Luxe sedan shown) an enthusiastic check mark. At the touch of a lever they adjust to any position from a road-racing stance to a throughway slouch.

I like the warning light that comes on when gas is down to a gallon, but wish the car had an engine-temperature gauge. The two-toned horn has a dulcet tip-of-the-hat note for lady pedestrians, plus a plaintive but penetrating one for highway use. One trouble is hitting the horn ring in a hurry—it's inside and under the wheel rim.

The steering wheel should be redesigned to eliminate a nastily protruding hub. Some drivers, too, may wish for a foot dimmer instead of the push-pull knob that sticks out of the steering column.

Timed signals. Turn signals are set by a lever on top of the inner steering-wheel hub, and stay on no matter how you turn the wheel. When you flip the lever over, the signals start blinking and current flows to a heater wire wound around a bimetal strip.

In a few seconds the heat warps the strip enough to make it trip a contact lever, opening the heater circuit. On cooling, the strip springs back, finally tripping another contact that breaks the signal circuit. As the total "on" interval is about 15 seconds, you have to reset the lever if traffic delays the intended turn. But you're still one up on those dopey characters who keep signaling a turn they made miles back.

The Simca speedometer lies doggo until you go 10 m.p.h., which is where the dial starts. A single lever controls both venti-

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lation and heating, the latter indifferent until you slip a fiber blind into position before the radiator.

Unitized construction makes the Simca draft-, rain- and rattle-resistant. But it also means that a crumpled fender has to be chiseled off along the weld, making for costly body repairs. The front doors slam with a regrettably tinny sound, though they fit so well that, with all windows shut, they are hard to close against the trapped air pressure inside.

What's in a name? That name Simca is a batch of initials standing for Société Industrielle de Mécanique et Carrosserie Automobile (roughly, Automotive Machinery and Body Manufacturing Co.) of Nanterre. The company also makes a line of trucks, tractors and farm machinery.

The first Simcas shipped here went to California in 1956. Mushrooming sales in 1957 quadrupled in 1958. Chrysler, shooting for a 15-percent share of the imported-car market, has set up Simca parts depots in five key areas, is unloading cars at nine ports, and last year began training mechanics in Simca servicing.

Eight Simca cars will be offered, starting with the De Luxe sedan at $1,698. The Super De Luxe sedan at $1,798 has a nicer interior, reclining-back front seats that make up into a bed, a windshield washer and a dash of chrome trim. These and the Chatelaine, a two-door station wagon at $1,963, all have the 48-hp. engine.

The higher-compression 57-horse engine will be in the Plein Ciel, a two-door hardtop at $2,947, and the Oceane convertible, topping the line at $3,167.

This hot little engine will also power the Simca Ariane, a four-door sedan on a 106-inch wheelbase, at $2,102. There will also be two vestpocket V-8s on a 106-inch base, an Ariane at $2,264, and the Vedette Beaulieu at $2,501. The long-stroke 90-degree V engine develops 84 hp. on 7.2:1 compression.

In France, Simca offers cars with the Simcamatic clutch, a vacuum-electric servo deal that eliminates the floor pedal. The clutch engages as you open the throttle, and an overriding switch in the shift stick prevents gear-gnashing catastrophes. It may be available here, Chrysler says cautiously, later on. END

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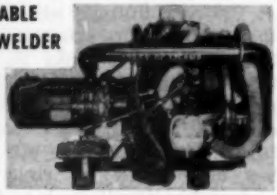

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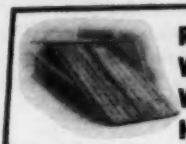

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Getting the Best Brake Job
[*Continued from page 206*]

owners do it all the time, and there's no reason to toss away good brakes for new ones. Wheel cylinders are worth gambling on, if they look okay at inspection. Five to one isn't bad odds, and how long you plan to keep the car can swing the decision. Drums are seldom perfectly smooth after wearing out a set of linings, and if only lightly scored, *don't* have them turned. But distinct grooves that also showed up in the lining should be removed by turning. Grooved lining must be replaced.

If the master cylinder checks out okay and shows no trace of leakage, leave it alone. If it goes bad later, it won't affect the brakes.

What about costs? A reline on one of the Big Three cars should run about $22. Heavier cars in the Lincoln-Caddy class with wider, thicker lining can cost $32 or more. Honing a wheel cylinder, installing new cups and pistons, plus bleeding the system runs about $4 a wheel, and should be done in pairs—if the left front needs it, do the right front, too. Drums average $2 to $2.20 per turning; replacements, about $7. Squeal-silencing springs range from $4 to $5 per set of four depending on the make of car. A good brake job on a moderate-priced car should not be a surprise at $50. Beware of curb signs that shout complete brake jobs for $14.

Did you get a good job? For the first 500 miles the pedal won't feel right, and stopping may be slightly uneven. But if you feel a severe grab or pull to one side, head back to the brake shop. A wheel cylinder may be hemorrhaging. Try the road test again. A 20-foot stop at 20 m.p.h. should be a breeze.

Best of all, pull a wheel and take a look at the new linings, wheel cylinders and drums to be sure you got what you paid for. If anything looks flubbed over, go back to the shop and raise the roof. So few people do that you'll be a surprising exception. In this final inspection, make sure the mechanic has put back the rubber adjustment-slot covers. Otherwise, dirt and grit will soon make you a preferred customer.

Some shops will give you a free brake adjustment after the new linings have worn in. But this is about all the follow-up service you should expect. END

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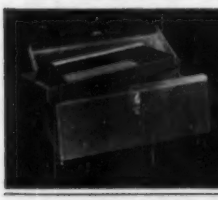

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Can We Catch Up on A-Planes?

[*Continued from page 119*]

Piped to a stack, the engines' radioactive exhaust was dissipated high above ground. Their metallic-fueled, water moderated reactor was the first to approach the high power required for an A-plane—but its size looked more suited to the engine room of the Queen Mary. (One reason, said GE: extra-heavy shielding, to let experimenters get near.)

Similar, more-advanced secret trials followed—until the latest reactor's controls failed, accidentally loosing enough radioactivity to contaminate 1,500 acres of the site. Pending repairs to the reactor if possible, tests halted. Still to be completed was the first Idaho facility able to ground-test a flyable engine.

That was the way our A-plane program stood as this was written.

Why haven't we got an A-plane yet? The answer has two parts. First come the enormous technical difficulties:

The men in the A-plane are its biggest problem. Shielding must protect them from the radioactivity of a reactor of perhaps 300,000 kilowatts or more, powerful enough to light a whole city; unshielded, it would endanger a person a mile away. The shield will be the heaviest part of the plane—whose size, design, ability even to fly at all, depend upon just *how* heavy the shield must be.

And that hangs in turn upon the agonizing question of how much radioactivity an A-plane crewman should be asked to take. For limited periods, instead of the usual ultraconservative standard for everyday exposure, something nearer an accepted "emergency" dose might apply. There has even been serious talk of one-shot crews who would use up a lifetime's radiation allowance in a single flight and then, "burned out" in atomic workers' slang, would be retired from A-plane duty. But recent advances in shielding promise a less extreme solution.

Specifications for the A-engine itself are an engineer's nightmare. The hotter it runs, the better—but the more nearly impossible to find materials that can stand up. The smaller the reactor, the simpler the problem of shielding and weight—but the more difficult to provide for an extreme rate of heat transfer, and for unimpeded flow of air or liquid metal through thousands of passages. Irrecon-

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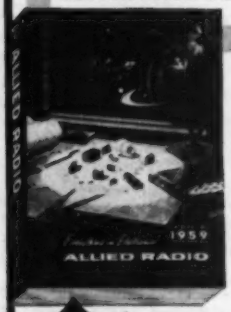

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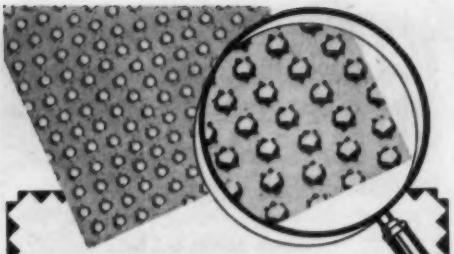

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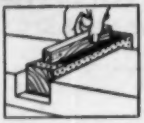

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Can We Catch Up on A-Planes?

cilable as these requirements look, however, dedicated A-plane workers consider them a challenge.

The sorrier side. The other side of our A-plane's earthbound status to date is a story of handicaps of a different sort.

Given its first home in tar-paper shacks in a state of disrepair, left over from the wartime Thermal Diffusion Plant at Oak Ridge, Tenn., our A-plane program has been an ugly duckling from that inauspicious beginning. Early and influential opposition to it amounted to a veritable intrigue. Opponents of the project brought about its review in 1948 by a MIT scientific group, reportedly expecting an unfavorable verdict that would kill it; instead, the resulting Lexington Report endorsed it as feasible.

NEXT MONTH: Behind the scenes at our bustling missile base at Canaveral—where everything builds up to those tense seconds of the countdown. Don't miss Frank Harvey's Close-Up on Canaveral . . . in March Popular Science.

Hampering later progress, say staunch friends of the program in Congress, have been divided responsibility, indecision, cutbacks in funds. Developing an A-plane is expensive business (only three nations could afford it, the U.S., England, and Russia, an expert has said) and Government economy waves have taken disastrous effect. Plans to flight-test an A-powered B-36 were canceled in 1953; a supersonic A-bomber project, Weapon System 125A, was called off in 1956.

And only last year, a "Fly Early" proposal to adapt an existing plane to A-power was rejected, on the ground that it would divert effort from the ideal A-plane we hope to get some day. With that Administration-backed decision, defense officials resigned themselves to seeing a Russian one fly first.

What happens now? Can we catch up with the Russians, before swarms of Red A-planes menace us? That will be a "hot subject of inquiry" in the present session of Congress, prominent members promise. And if nothing else can spur our lagging program, perhaps the Sputnik-like shock of a publicly flaunted Russian A-plane will. Americans can only hope it will be in time. END

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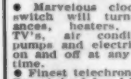

● Modern hi-efficiency attractive dial phone. Use for extension to main line on private system. Use several for complete private system, etc. Complete with ringer, dial, etc. Work on any system. Govt. cost $25.00. SALE..... $9.98 Ppd.

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● Outstanding brand new surplus unit. Heavy duty DeLuxe generator. Nominal rating 500-w but will deliver up to 1000-w of 60-c, 120-v power. Speed 3,600 r.p.m.

● Complete ready to use. Size 9" diameter, 10" wide, 10" high—14" overall. Shaft 2" long, ¾" diameter. Finest ball bearings. Wt. 52 lbs. Brand new in original crate.

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● 2½", 16,500 gph. Centrifugal. All bronze ball bearing. New. 39 lbs. Govt. cost $103. SALE ..... $49.50 FOB

● Also 1½" 6000 gpm pump. Govt. cost $62.50. SALE..... $23.95 FOB

115-V AC and 30-V DC GENERATOR

● Air Corps ball bearing unit. Puts out 115-v, 1500-w, 800 cycle, AC and 30-v, 75 amp DC.

● Makes good small welder, battery charger or will furnish 115-v for lights, stove, iron, etc. Size 6"x9"x15". Wt. 50 lbs. Full instructions. Govt. cost over $200. SALE.... $19.71 FOB

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- ● Leading make ½" Electric Drill..... $27.95
- ● 29-Piece Drill Bit Set..... 7.95
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NAME_____

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New Small Car Runs on Electricity

[Continued from page 105]

28-lb. carbon-pile controller, 19⅝ inches long.

The Town-About's accelerator is linked to the carbon-pile controller by a spring-loaded cable. When the driver presses on the accelerator, it is as if he were moving the lever of a rheostat.

528 pounds of batteries. The little electric two-door coupe—that is the only body type offered—gets its current from a tray of 24 two-volt battery cells under its rear seat. The cells are replaceable individually and have spillproof caps. To get at them, you fold the seat up against its back. The lead-acid batteries are conventional except that selenium has been alloyed with lead in them. This permits thinner plates to be used, thus knocking 216 pounds off the car's total weight. Even with the selenium, though, the batteries weigh 528 pounds. They also supply current for the car's lights, horn and windshield wipers.

When fully depleted, they can be recharged in seven hours. The rectifier needed for the job comes with the car. It can be plugged into any 110-volt outlet, and has an automatic control that prevents overcharging. The owner can either carry his rectifier with him—on a rack designed for it under the hood, which is the Town-About's luggage compartment—or keep it in his garage.

Most Town-About owners will want to recharge batteries during the night, and power companies will do their best to encourage this practice, for they are eager to build up lucrative loads during the off-peak hours. That is why a number of them are sponsoring the Town-About and, to help advertise the car, buying it for their meter-readers to drive.

Noise: "a faint whine." The Town-About is very simple to handle, as you would expect, and nearly noiseless. You switch on the current with a key and then step on the accelerator. The only sound you hear as you move forward, except for the slight rumble of the car's body, is a faint whine from the motors. If you want to go backward, you press a button on the dash and again prod the accelerator. When you are halted at a stoplight, the car is wholly silent, for it isn't using any current at all.

On the steering post there is a hand

Heavy Duty, All Steel

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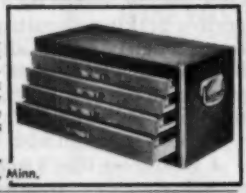

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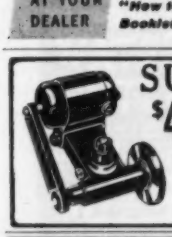

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Another new unit is the Miller Electric Rodder which has patented cutters that expand automatically to the size of the pipe. It will clean out heavy obstructions in pipe diameters 3" to 12". Smaller Sizes available. But now, what are these Tools worth in **COSTLY PLUMBING BILLS SAVED.** Tear this Ad out—and write your name and address beside it for **FREE BOOKLET** on Hand and Electric Units. Obey that urge. No Agent will call. A postcard will do (Chicago Phone Kildare 5-1702)

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New Small Car Runs on Electricity

shift with two positions: Low Range, for brisk takeoffs or climbing hills and Driving Range, for average touring.

The car has hydraulic brakes with drums two inches wide. The builders considered using electricity itself to hold back the car, either by dynamic or regenerative braking circuitry. But either system, though of proven effectiveness, would have increased the cost, weight and complexity of the car. Furthermore, they felt that the possibility of failure was greater with electrical than with hydraulic brakes.

A voltmeter like a gas gauge. There is no oil gauge or temperature gauge on the Town-About's instrument panel, of course, nor any hump in the floor. But there are three new dials on the dash: two ammeters and a voltmeter. The ammeters have conventional dials, and the driver of the Town-About merely has to make sure that they are registering alike. The voltmeter has had its face changed so that it reads like a gasoline gauge. Two-thirds of the range of the needle from "Full" to "Empty" is painted green. The remaining segment is two-thirds yellow, one-third red. When the needle has swung over to the red zone, it's high time for the Town-About to head for the nearest 110-volt outlet and settle down for a recharge.

But even if the car appears to die on the road, the batteries have a last-gasp recuperative power that may take it back to its garage. The manufacturers say that if the driver will just sit there for five minutes with the power turned off, the batteries will recoup enough to sustain six more miles of driving at 30-m.p.h.

Fiber-glass and aluminum. The body of the Town-About, which has torsion-bar suspension, is made of molded fiber-glass, like a Corvette's, and weighs only 300 lb. It covers a frame of welded aluminum tubing, strong enough to prevent crushing in case the Town-About should flip over.

Ostensibly, the Town-About will seat four people, though two of them had better be small children. It is 13½ feet long, five feet wide, four feet nine inches high and has a wheelbase just a trifle less than eight feet long.

Its makers declare that the Town-About is an ideal candidate for the second car in any urban or suburban family. Since it has no exhaust, they even tout it as one sure solution to the problem of smog. END

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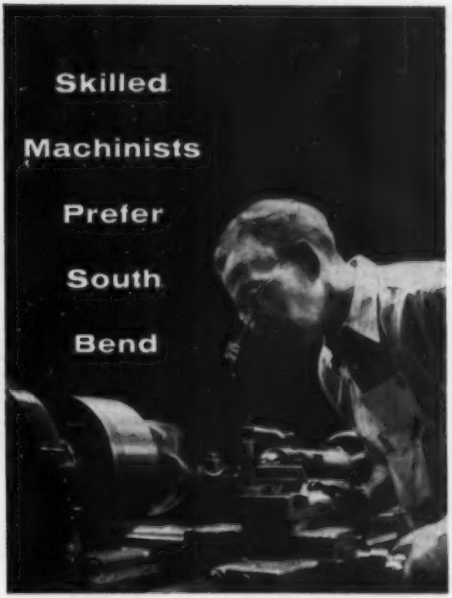

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[Continued from page 114]

sults from fuel fall-out and condensation built up in the crankcase during low-speed operation. The operator feels it as a staggering ragged response to quick throttle opening.

Further improvement on the Scott 60 comes from three carburetors which feed individual cylinders at low speed but balance through a tube at high speeds. Scott engineers explained that the higher air velocity through the small venturis helps keep the fuel in the air stream. In this connection Outboard Marine feels that their thermostats help reduce puddling, and Mercury points to small bore design, lack of manifold, and internal reed valves as definitely beneficial. Tilted power heads on some Mercury models also reduce the problem.

A further nod towards automotive practice is Scott's dash panel with red warning lights to indicate battery discharge or engine overheating.

This year, Scott boosted its 22-horsepower engine to 25 horses by piston, port, and manifold changes. In this power range all manufacturers appear to be aware of the water-skiing fraternity. A check of the listed power ratings indicates that you will have a choice between an engine that will definitely "get up" a skier, and a fisherman's model. The disappointing intermediate that couldn't quite bring skier and boat to planing speed is a thing of the past.

Summing up. A discussion of the 1959 models with outboard engineers brings to light a number of problems that have been licked in reaching the present state of refinement. This year's outboards are on near par with automobiles for operating ease, reliability and general faithfulness. Unlike auto engineers, however, the outboard men evidence a healthy individuality. It is expressed in the widely separated thinking on bore sizes and cylinder arrangements. Whereas Scott, Outboard Marine, and others have large-bore cylinders, Mercury minces no words in pointing out a preference for small bores. On the other hand, Scott and Mercury both claim optimum compactness from vertical in-line cylinders, an important feature when two or more engines mount on the same transom. Johnson and Evinrude, however, favor the stiff, rugged crankshaft they feel is inherent in the V-4.

But outboard problems are by no means a closed book. Spark-plug life is still dubious, and although it would probably be nice if non-additive fuel were generally available, the facts are that the public will continue to operate on automobile fuel and the outboard will have to live with it.

An even greater problem seems to be oils, and one top engineer predicts the wider marketing of an outboard oil with special additives not cursed by deposit formations that break up and swirl about in the combustion chambers, some of them latching onto the spark plugs.

Mechanical service from your outboard dealer in the future will be better. Builders have worked mightily to reduce the number of points where owners can jimmy them out of adjustment. An example of this is the fixed-jet carburetor used on some Mercury models. Nevertheless, convenience and high power breed their own complexities as they have in modern automobiles, and most outboard manufacturers are now working on training programs to keep dealer mechanics hep.

Part of this year's outboard trend results from a catching-up period after last year's extensive, and expensive, changes in production tooling. But another part shows a definite maturing and sense of public responsibility. The outboard industry has grown up. Its leaders are very much concerned with making a safe, reliable and manageable power plant for the family boat. Talk to them, and they'll tell you that part of the job belongs to the boat builder, and he's been scrambling just as busily as the outboard boys to keep pace. In the past, engineering confusion and badly mismatched boats have sometimes resulted. Now, standardization groups of enginemen and boatmen are working together, to pin down factors you as an owner have little control over.

Hull design, transom strength and dimensions, control installations, and all the angles, connections, heights, curves, and offsets natural to a boat are rapidly getting the treatment that the SAE gave the automotive industry years ago.

As a result, your '59 boat-and-motor combination will be a lot less of a gamble than in the past. END

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U.S. ARMY **FOLDING SHOVEL** — Has 20" wood handle. Blade will fold to form pick or shovel. Carry in car as emergency tool.

PICKMATTOCK — Has 12" steel head with pick on one side, mattock on other. Ideal for garden or camp. U.S. ARMY

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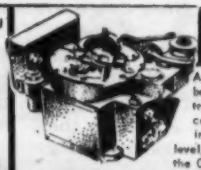

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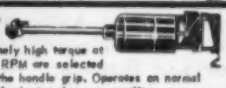

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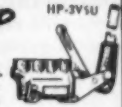

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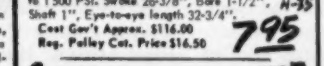

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[Continued from page 97]

head valves for 1961. Why a six? Because Chrysler's iron V-8s are relatively new, and have plenty of room for future horsepower increases. Their six is old as the hills, and moderate owner use makes a six ideal for production in die-cast aluminum with metal-sprayed aluminum liners.

Ford drawing boards are littered with aluminum V-8s, sixes, and fours, backed by an impressive program of testing aluminum replicas of every 1959 Ford-built engine. The Mercury-Lincoln engine is considered highly suitable for aluminum casting, with likely 1960 changes being use of this metal for the intake manifold, heads, and oil pan. Although one Ford engineer told POPULAR SCIENCE, "We have no definite deadline for aluminum engines," a four-cylinder industrial engine is reported to have been hastily redesigned for aluminum so it can be dropped into Ford's smaller car.

In General Motors circles Buick is developing an aluminum engine and has a general program of replacing iron with aluminum. Oldsmobile built several aluminum V-8 engines weighing 120 pounds for block and heads. (Identical parts of cast iron weighed 330 pounds.) Most GM engines are overdue for replacement, having lately approached their limits of expansion. Reports indicate that GM plans a common engine for most 1960 lines, somewhat as a common body is used in 1959. It is expected to appear first in cast iron, with bore-and-stroke differences providing spacing between nameplates. A large version could show up later in aluminum for Cadillac. GM is believed to be most likely to use permanent-mold aluminum V-8s—to make use of their tremendous iron-foundry capacity.

"Chevrolittle's" flat six, the engine being readied for GM's light car, is designed for die casting, with 10 pre-production blocks being produced daily at the Tonawanda, New York, engine plant. Reynold's new $88-million reduction plant in Massena, New York, is planned to have an annual capacity of 100,000 tons of aluminum, equal to more than two million V-8 blocks.

Studebaker seems to have missed the stampede to aluminum, perhaps from preoccupation with the new Lark. They are in a position to shift quickly, however, due to their association with Mercedes, a leader in building aluminum engines. For the present, Studebaker men are mum on aluminum.

Who will be first and when? Tooling schedules indicate the first U. S. aluminum engine may come in the 1960 model year. It could be GM's flat six, under light panel trucks such as used by the milkman or baker. It's doubtful if Ford will release anything in aluminum for 1960, though Thunderbird could appear with an aluminum version of the present engine. Rambler may break through with their unique aluminum power plant. Another sleeper is the aluminum Chrysler six.

By 1961, Cadillac, Imperial and Lincoln may appear with aluminum engines supplying a satisfying performance wallop without penalties of horsepower or size increases. Other 1961 engines will sprout aluminum intake manifolds and radiators.

Most qualified observers agree that by 1962 there will be extensive use of aluminum blocks, hoods, manifolds, radiators, wheels, bumpers, battery cables and wiring. Little doubt exists that within 10 years auto makers will be the world's largest users of aluminum. For motorists, this means spacious, 25- to 30-mile-per-gallon cars with all the performance a road allows. Harry F. Barr, chief engineer for Chevrolet, says, "When a practical aluminum cylinder block is developed, we can look to a new specific output goal of one horsepower per pound of engine weight." Specific output for cast-iron blocks now averages one horsepower for 2½ pounds of engine. END

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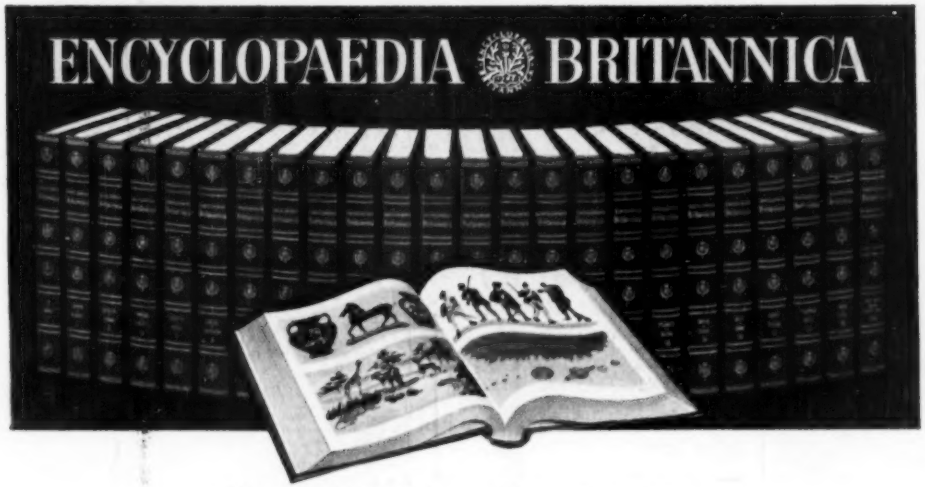

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